AVIATION

TOLEDO PUBLIC LIBRARY
TECHNOLOGY DEPARTMENT

CONTENTS FOR DECEMBER, 1944

Volume 43 • Number 12

Briefing for December 5
Down the Years in Aviation's Log 5
Editorial: Progress Has Been Made 115
Gas Turbines for Tomorrow's Superpower ..... *G. Geoffrey Smith* 116
***This* Is Our Air Policy — So Far** 119
Keep Those Contract Schools Going ..... *Earl D. Prudden* 120

Marketing

Here's Your Local Market ..... *Frank S. Christian* 122
Hang Your Shirt On a Star 125

SPECIAL MAINTENANCE SECTION
(See full table of contents on page 127)

Ten comprehensive feature articles . . . Beginning on page 130
Fifteen pages of AVIATION'S unmatched Maintenance Notebook . . . . . Beginning on page 155

PLUS

AVIATION'S Maintenance Awards for 1944—
To United Air Lines 128
To Chicago & Southern Air Lines 129

Aviation Research—Engineering—Production

Compressibility Calls a Challenge ..... *Costas Ernest Pappas* 171
Pre-Viewing Tomorrow's Metal Designs ..... *Chester S. Ricker* 176
Heavy Duty Runway Built by New Techniques ..... *Rhodes R. Rule and John F. L. Bate* 178
Plant-Practice Highlights 180
Aviation's Engineering Data Book 207
For Better Design 197
Aviation's Sketch Book of Design Detail 203
Review of Patents ..... *A. Harry Crowell* 208
New Products and Practices 241

Flying Equipment

Boeing's Model 377 Stratocruiser 181
Republic Presents Personal Amphibian 182
Handley Page Bid for Transport Market 183

Air Transport

Give Operators More Cruise-Control Data ..... *James B. Rea* 184
When You're Planning Payloads— ..... *James J. Heatley* 186

Finance

Aircraft Stocks Climb Out of Bear Pit ..... *Raymond L. Hoadley* 187

Military

Repairing 'Round the World 188

Civil Operations

Service and a Paintbrush Bring and Hold New Business ..... *William D. Strohmeier* 194

Book Reviews 208

Side Slips 239

The Aviation News

National Aviation 217
War Communique No. 36 221
Washington Windsock 223
Aviation Manufacturing 224
Transport Aviation 227
Aviation Abroad 233
Financial Notes 235
Aviation People 237

George W. Pfeil, *Publisher* — Leslie E. Neville, *Editor*

John Foster, Jr. ..... *Managing Editor*
Herb Powell ..... *Associate Editor*
Edward E. Thorp ..... *Assistant Editor*
Irving Stone ..... *Assistant Editor*
Raymond Hoadley ..... *Financial Editor*
Wm. R. Nelson ..... *West Coast Editor*
Blaine Stubblefield ..... *Washington Editor*
Dallas Mallard ..... *Art Editor*
Paul Wooton ... *Chief of Washington Bureau*

★ ★ ★

On leave of Absence With Government Services

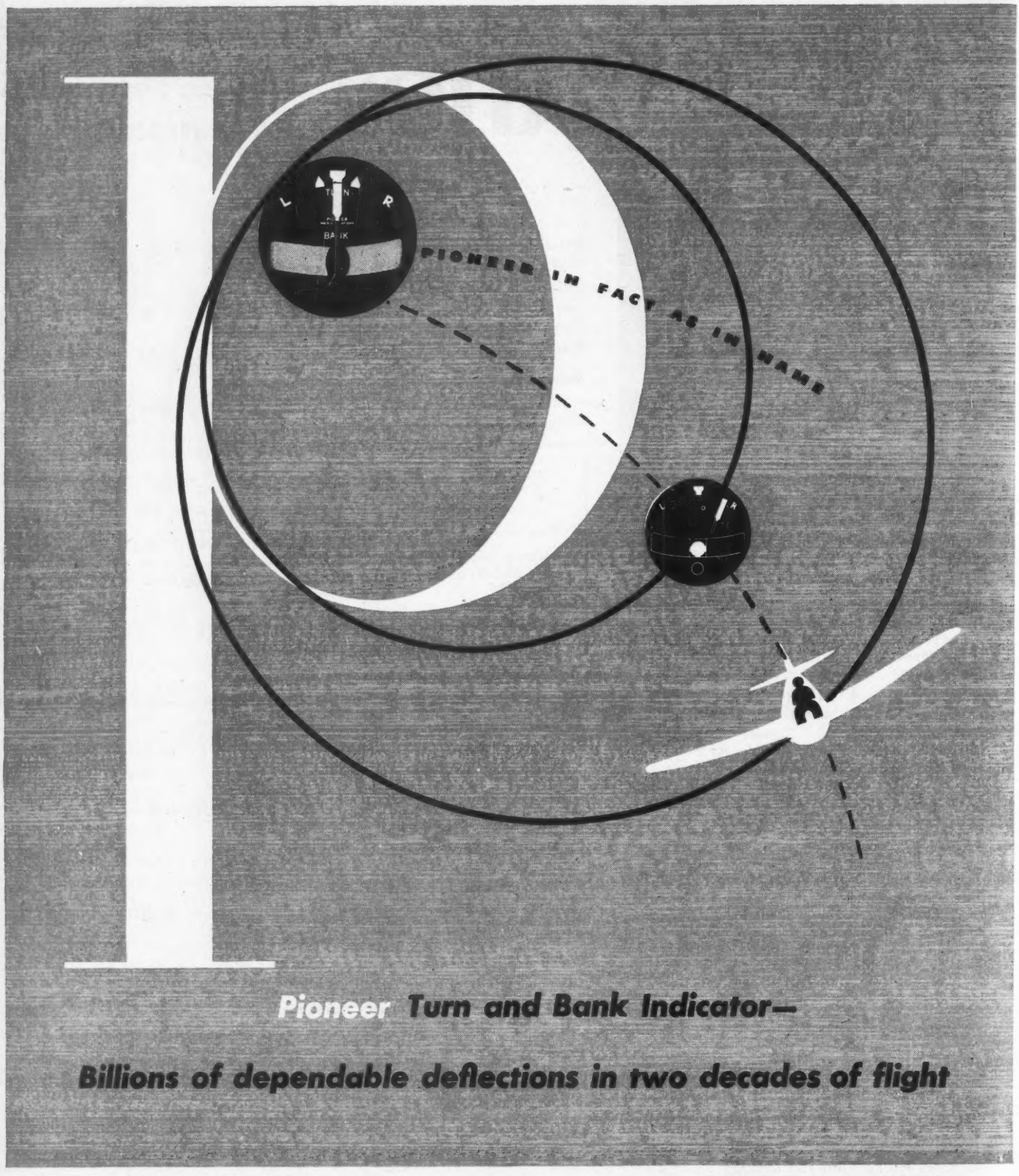
Carl Norcross ..... *Colonel, Air Forces*
Charles F. McReynolds .... *Major, Air Forces*
Jay P. AuWerter ..... *Major, Air Forces*
Randolph Hawthorne ..... *Captain, Air Forces*
Kenneth D. Reynolds ..... *Lieutenant, Infantry*
David Baker ..... *Private, Air Forces*
Don Fink ..... *Special Assignment*

★ ★ ★

Andrew B. Martin, *Sales Manager*

District Managers: Boston, Hunter Snead; New York, Robert F. Boger; Philadelphia, C. M. Edler and E. M. Schellenger; Cleveland, A. H. Bartsch and R. S. Cobb; Detroit, C. W. Evaul; Chicago, A. E. Meanor; St. Louis, W. E. Donnell; Los Angeles, E. W. Potter; San Francisco, John Otterson.

McGRAW-HILL PUBLISHING CO., INC. Publication office 99-129 North Broadway, Albany, N. Y. Return postage guaranteed. Editorial and executive offices, 330 West 42nd Street, New York, 18, N. Y. Branch offices: Chicago, 520 North Michigan Ave.; San Francisco, 68 Post Street; Aldwych House, Aldwych, London, W.C. 2; National Press Bldg., Washington; 16 South Broad St., Philadelphia; Hanna Bldg., Cleveland; 2-144 General Motors Bldg., Detroit; Paul Brown Bldg., St. Louis; 1427 Statler Bldg., Boston; Rhodes-Haverty Bldg., Atlanta; 621 S. Hope, Los Angeles; 738-9 Oliver Bldg., Pittsburgh. JAMES H. McGRAW, Founder and Honorary Chairman; JAMES H. McGRAW, Jr., President; HOWARD EHRLICH, Executive Vice-President for Business Operations; JOHN ABBINK, Executive Vice-President for Editorial Operations; CURTIS W. McGRAW, Vice-President and Treasurer; JOSEPH A. GERARDI, Secretary; J. E. BLACKBURN, Jr., Director of Circulation, Aviation, 330 W. 42nd Street, New York. Published monthly, price 50c a copy, 50c in Canada. Allow at least ten days for change of address. All communications about subscriptions should be addressed to Director of Circulation, 330 West 42nd Street, New York. Subscription rates—United States, Mexico and Central American Countries, $3.00 a year, $4.00 for two years, $5.00 for three years. Canada, $3.50 for one year, $5.00 for two years, $6.00 for three years, payable in Canadian currency at par. Great Britain and British Possessions 30 shillings per year, 60 shillings for three years. All other countries, $5.00 a year, $10.00 for three years. Entered as second-class matter September 3, 1936, at the Post Office, Albany, New York, under the Act of March 3, 1879. Volume 43, Number 12. Printed in U. S. A. Cable Address: "McGraw-hill New York." Member A.B.C. Copyright 1944 by McGraw-Hill Publishing Company, Inc., 330 West 42nd Street, New York, N. Y. The contents of this issue are copyrighted and may not be reproduced without the permission of the copyright owner. The following publication is combined with AVIATION: AERONAUTICAL ENGINEERING AIRCRAFT JOURNAL. All rights to this name are reserved by the McGraw-Hill Publishing Co. Aviation is indexed in Guide to Periodical Literature and in Industrial Arts Index.



Pioneer Turn and Bank Indicator—

Billions of dependable deflections in two decades of flight

A Pioneer "first" we are particularly proud of is the Pioneer Turn and Bank Indicator. Almost twenty years ago the first turn and bank indicator was manufactured and sold by Pioneer. This sturdy member of the Pioneer primary flight-security group has provided steadfast indications of rate of turn and lateral stability for hundreds of thousands of pilots throughout the world. Its rugged design and close-tolerance calibration have meant dependable readings through literally billions of pointer deflections, earning the admiration of flying and service personnel everywhere —another tribute to the Creative Engineering-plus principle which guides Pioneer.

PIONEER INSTRUMENTS *ECLIPSE-PIONEER DIVISION* **Bendix** *AVIATION CORPORATION*

Bendix and Pioneer are trademarks of Bendix Aviation Corporation

Teterboro, N.J.

Briefing for December

Eight years ago AVIATION initiated its Maintenance Award — the first such recognition to be given those unsung lads who then were generally referred to as grease monkeys. Purpose of the award then, as now, was to encourage more efficient maintenance procedures and developments and to give recognition to the men on whom so much of air transport's magnificient record and progress depends. This year, the judges report, the pleasant task of making this oldest award was the most difficult ever—"because everybody's doing such a hell of a swell job." But they cast their ballots, and up came the '44 champs: United and Chicago & Southern, whose citations you'll find on pages 128 and 129.

Since maintenance knows no barriers, we've enlarged the scope of the special section this year, and in the ten feature articles and thirty illustrated Maintenance Notebook items there are practical easy-to-adapt ideas from the manufacturing, military, component-parts, and fixed base fields as well as the airlines. And to make it easier to locate them all, you'll find a special Maintenance Section Table of Contents on page 127.

G. Geoffrey Smith, editorial director of the English magazines *Flight* and *Aircraft Production,* is one of the pioneer gas turbine and jet propulsion advocates and also one of the most prolific writers on these increasingly important subjects. With the knowledge that the industry well understands the principles of turbine power, he goes on from there to analyze the problems which remain to be solved and gives several new thought provoking angles opening new avenues of development to the alert engineer. Page 116.

Three important new airplanes are announced—two American and one British. Initial specifications of Boeing's Model 377 Stratocruiser, transport-version of the B-29 Superfortress, a tremendous craft with just as tremendous potentialities, together with illustrations, are on page 181. The other American craft is for the personal plane field—Republic's four-place amphibian, an unusual and mighty interesting design, detailed and illustrated on page 182. The British job is Handley Page's bid for postwar transport markets, the four-engine Hermes; the specifications and illustrations will be found on page 183.

COSTAS ERNEST PAPPAS, chief of aerodynamics for Republic Aviation Corp. and 1943 winner of the Wright Brothers medal for outstanding contribution to the field of aeronautical engineering, knows that compressibility is not a hazy theoretical problem to be conquered sometime in the future—he knows it's already facing us today as a challenge to every design and production engineer. In his pointed article, beginning on page 171, he makes an important contribution to the literature in this ever-more-important field.

So many people have used our study "Here Are Your Markets" (May, June, and July AVIATION) to advantage that we couldn't quit giving such serviceable articles even if we wanted to. By way of proving we *will* continue with this type of survey, we present "Here Are Your Local Markets" by Frank S. Christian (page 122). It not only tells the dealers and distributors just how to make accurate market studies in any given territory, it also gives a thoroughly workable merchandising plan to exploit that territory most efficiently and economically.

Our Transport section this month features two Jims, both veterans who really know what they're talking about. Jim Rea, Convair engineering test pilot, has an article on page 184 that's of as much interest to the aircraft manufacturer as to the airline operator, for he goes into the latter's need for basic test-flight data, much of which could come from the plane producers. The other Jim—Heatley, American Export operations engineer—presents a straightforward article which also has a two-way value, for on page 186 he details a fuel-weight evaluation that takes into consideration the many elements which upset flight economy, and "When You're Planning Payloads" these factors really get important.

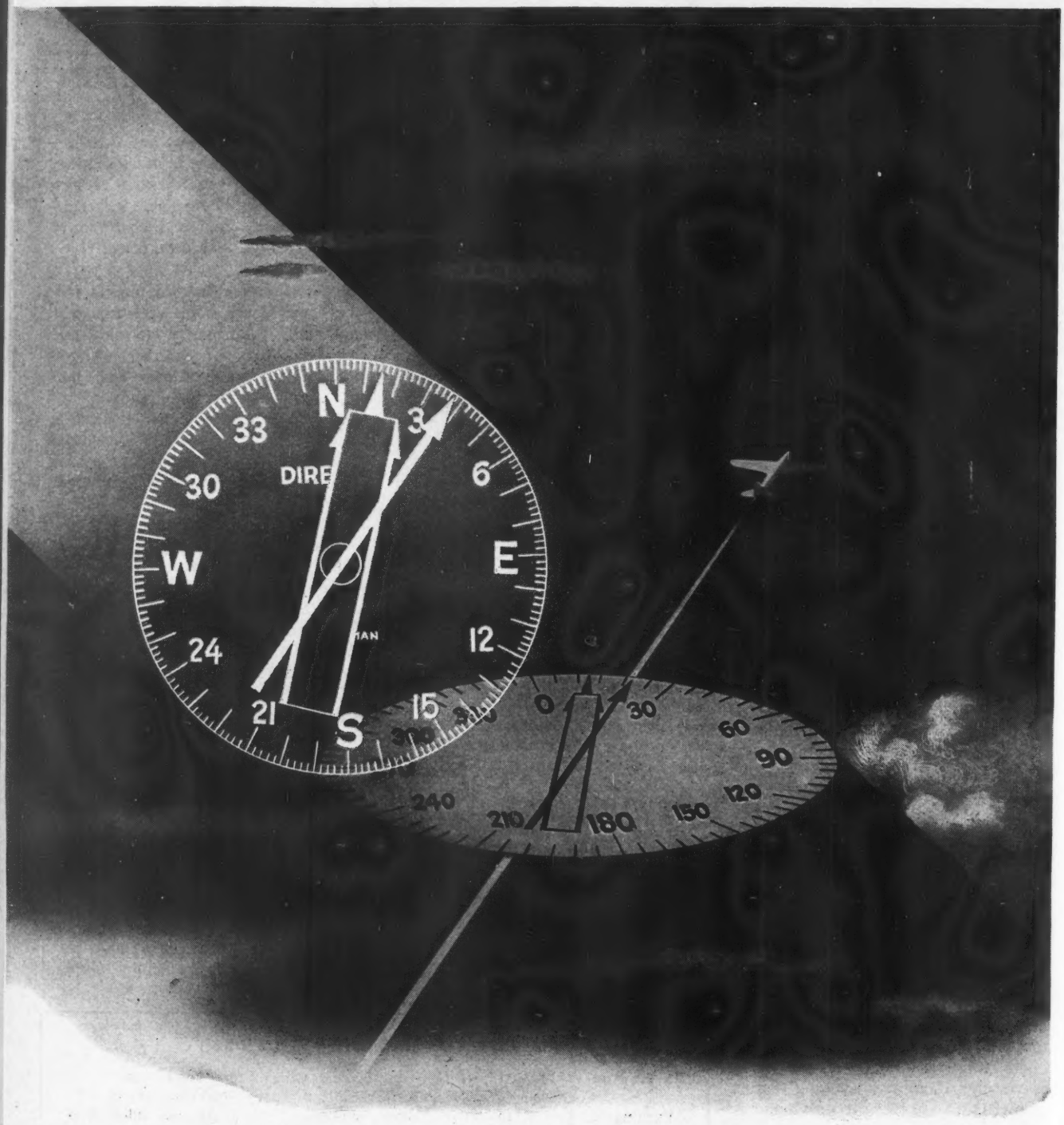
With a lot of people foolishly thinking the war's practically over, it's no wonder an even greater number are forgetting the superb and desperately needed pilot-training job our civilian contractors did to train pilots for the world's greatest air force. That's why *now* is the time to give them the recognition they deserve and, more important, keep them as a permanent part of the training establishment. Turn to page 120, where Earl D. Prudden says "Keep Those Contract Schools Going."

Down the Years in AVIATION'S Log

25 Yr. Ago (1919)—All airmail records broken between N. Y. C. and Washington by deHavilland plane, which carried 630 lb. over the 218 mi. in 1 hr. 34 min. . . English initiate airmail to Belgium, Holland, Norway, and Denmark. . . First aero show in West is opened in Chicago.

15 Yr. Ago (1929)— Comdr. Byrd flies Ford Trimotor over South Pole. . . .Los Angeles judge dismisses suit against airman who flew low, saying "Railroads are as noisy and perhaps as dangerous." . . . Costes and Bellonte fly 4,902 mi. non-stop from France to Manchuria . . . Pres. Hoover asks Congress for $33,000,000 for Air Service . . . Moth plane takes off from top of moving auto at Orchard Beach . . . Caproni 6-engine bomber with 150 ft. span, flies 138 mph. with 9-ton bomb load. . . Chilean Army buys two Ford Trimotors. . . Los Angeles holds first glider meet.

10 Yr. Ago (1934)— TWA makes Floyd Bennett Field its N. Y. terminal. . . . EAL DC-3 flies Los Angeles-Newark run in 12 hr. 3 min. at 216 mph. . . Same EAL plane makes N.Y.C.-Miami 2,400-mi. round trip in 14 hr. 55 min. . . Panam projects California - Honolulu - Manila - China route with Sikorsky S-42's. . . . First French full-scale wind tunnel built at Chalais-Meudon. . . Autogiro lands on N.Y.C. East River pier. . . Total of 1,285 planes built in U. S. in first 9 mo. of yr., 21 percent gain over 1933. . . Stinson delivers 600th four-passenger plane. . . Private flying ban lifted in Canal Zone.



SIMPLIFIED COMPASS INDICATION for the pilot is one of the features of the Kollsman Direction Indicator. This new direct reading, easy-to-read, easy-to-follow compass has a convenient reference pointer that can be set to the desired course making it necessary only to "match pointers." It is regarded by many pilots as one of the greatest steps taken to simplify cross country navigation for the pilot. For an illustrated folder on this original Kollsman development, write Kollsman Instrument Division, 80-08 45th Avenue, Elmhurst, New York.

KOLLSMAN AIRCRAFT INSTRUMENTS

PRODUCT OF

SQUARE D COMPANY

ELMHURST, NEW YORK • GLENDALE, CALIFORNIA

The Parley Made Strides But There's Much to be Done

PROGRESS MADE at the International Civil Aviation Conference was distinctly heartening from two major aspects. First was that the delegates were, almost from the very start, in general agreement on the fundamental question of air sovereignty and the right of innocent passage and landing on foreign soil for refueling and servicing. Fortunately there is no disposition to establish closed zones or discriminating arrangements involving the rights of nations or groups of nations to portions of the air.

Thus there promises to be a sound groundwork for the development of postwar international air transport as an instrumentality for peace and prosperity rather than a breeder of future wars.

Perhaps even more important was the progress made toward closing the very wide gap between the American and Anglo-Canadian delegations regarding the question of the power which should be granted an international air authority. Originally the Empire delegates sought establishment of a body with power to license world air routes, fix schedules, and establish rates but, as this was written, they appeared to have made concessions bringing them more in line with American and other delegations' ideas of restricting the body to consultation and technical functions, allowing a greater degree of freedom for world airway development (also see pages 119 and 227).

THE ORIGINAL DISAGREEMENT was the product of a long-felt fear on the part of the British that we would gain an advantage over them as a result of our extensive world air transport operations during the war. But they seem to forget the fact that they, to, have established airlines in many parts of the world and improved their operating techniques tremendously in the past few years. And they, too, have developed designs for postwar commerical aircraft far more efficient than those they were operating prior to the advent of the war.

Conquest of the air knows no national boundaries and no nation has a monopoly on scientific discovery. The fundamentals of the aeronautical sciences are available to everyone, allies and enemies alike, and whoever blends them most ingeniously into a given design holds temporary leadership. It is unsound for one nation to freeze development until another catches up, because the state of the art at any given time is unimportant.

What really matters is the continuation of research, design development, and perfection of operating technique. Eternal research and application is the price of leadership for any nation.

If our progress were halted, even for a moment, it would represent a great disservice to our allies because air transport is one of the three basic elements of airpower. And it is only through possession of superior air power by nations of goodwill that it will be possible to maintain order in the world after it is restored.

IN THE MANY CONFERENCES that must follow before the detailed pattern of postwar aviation is woven, it is vitally important that the representatives of all nations take the broader view of the problems of civilian aviation. We cannot close our eyes to the truth that air transport is a basic ingredient of airpower, just as the merchant marine is in sea power. Air transport and military air forces, backed by a strong aircraft production industry constitute the only sound aviation program for any nation.

If we project into the third dimension the time-tested British policy of a properly balanced navy, merchant marine, and shipbuilding industry, we can find a formula for postwar airpower which will preserve peace and order and promote national and international prosperity far into the future.

Leslie E. Neville

EDITOR

Gas Turbines For Tomorrow's Superpower

By G. GEOFFREY SMITH, M. B. E.

A thought-provoking analysis by the noted British writer, who frankly appraises the problems to be solved to achieve utmost efficiency from turbine-compressor power units in the postwar era.

G. Geoffrey Smith, M.B.E., editorial director of the British magazines "Flight" and "Aircraft Production" and author of the book "Gas Turbines and Jet Propulsion for Aircraft," is one of the pioneer advocates of the turbine-compressor unit for aircraft power. In the accompanying article he gives stimulation for research and development along new lines leading to continued Anglo-American air leadership.

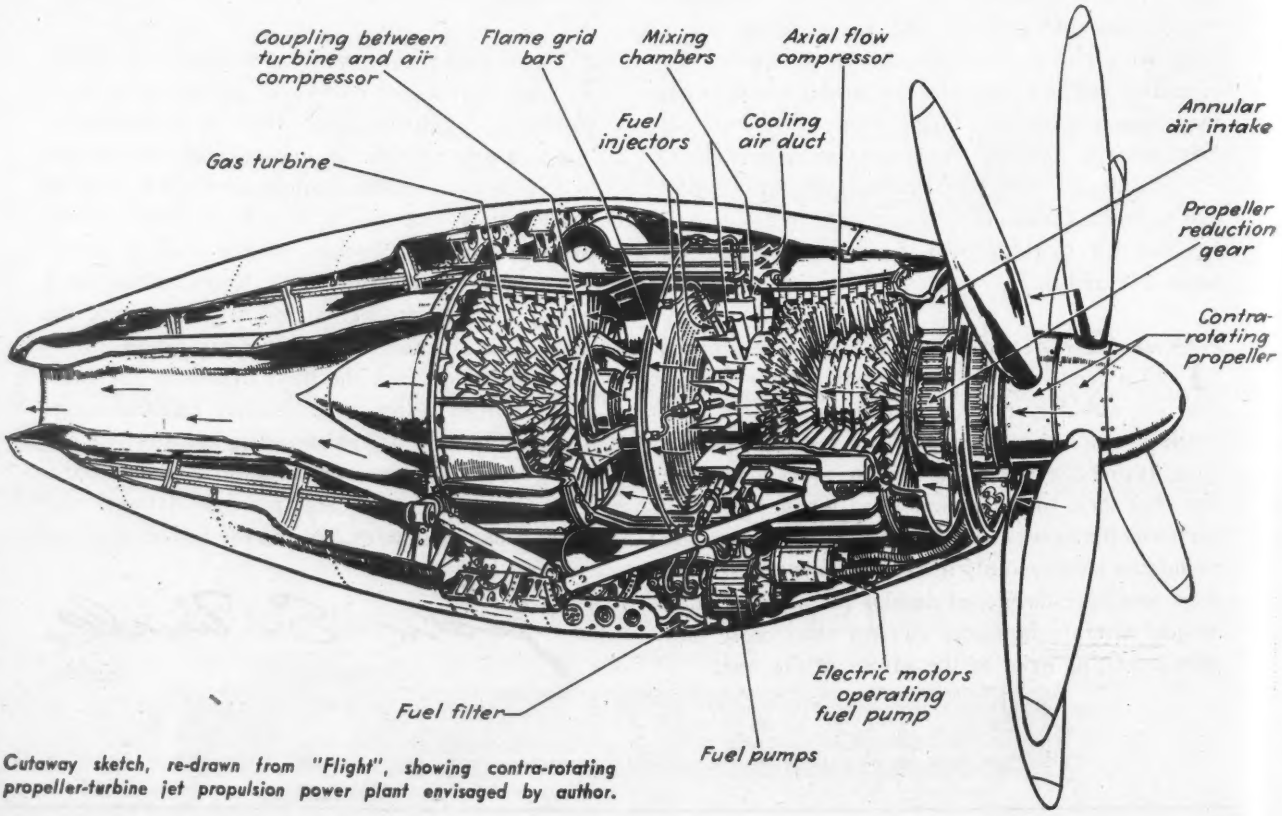
DESPITE PRESENT LIMITATIONS, evidence is mounting that the gas turbine power plant presents a definite challenge to the hitherto all-conquering reciprocating engine as the power plant for future aircraft.

The gas turbine possesses so many attributes that its claims to serious recognition are too strong to be resisted. In the postwar engineering world, power generation is almost certain to be revolutionized by further development of the gas turbine-compressor unit.

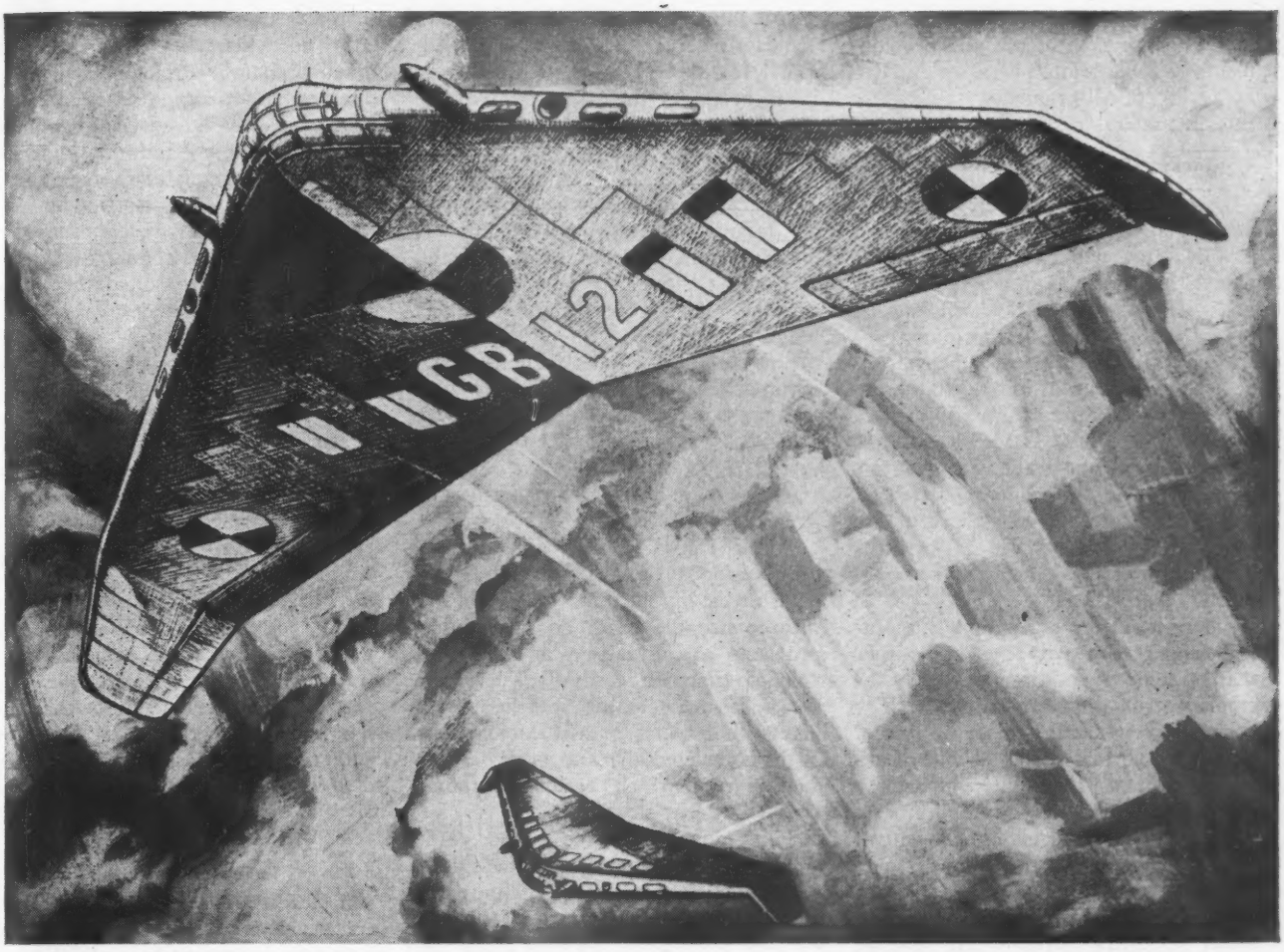
Outstanding among these attributes —and most thought-provoking for aircraft designers—are the turbine-compressor unit's small size for the power delivered; the ease of manufacturing and maintenance; and, perhaps most important, its adaptability for "tailor-made" design.

Fortunately the turbine and compressor can be adapated to produce either a continuous high speed jet sufficient to propel aircraft by reaction or, alternatively, arranged so that mechanical power may be derived from the common shaft on which the two components rotate. It is in the latter category that immense scope is offered for the application of gas turbines as prime movers, especially for large transport aircraft.

Since release of the joint Anglo-American announcement of successful jet aircraft, however, too much empha-



Cutaway sketch, re-drawn from "Flight", showing contra-rotating propeller-turbine jet propulsion power plant envisaged by author.



Artist's conception of all-wing transport aircraft of approximately 120-ft. span. Four or more turbine-compressor units would be buried in wing, with the two inboard driving contra-rotating propellers and the outboard pair producing propulsive jets. Air intakes for turbines would be utilized for boundary layer control. (Courtesy "Flight".)

sis has been placed on jet propulsion, rather than on the turbine which produces the jet. In the long view, perfection of the small gas turbine is of far greater significance, for it offers a means of providing a smooth, continuous flow of power from rotative units hitherto unattainable. It represents the second stage of the attack of rotative power units upon the orthodox reciprocating type.

In design thinking, the turbine should be regarded as a prime mover, able to perform the work of an orthodox engine by driving an airscrew, or even a series of airscrews. Some engineers, of course, back the simplicity of the propulsive jet, particularly for interceptor fighter craft. Others are equally confident that the turbine driving airscrews holds the greatest promise. Still others maintain that combinations of turbine-driven airscrews and pure jets will provide the answer.

The advent of small five-blade airscrews permitting an increase in rpm. without raising tip speeds to excessive levels opens up new possibilities. Coaxial, contra-rotating units offer even further avenues of development in this direction. The implication remains, though, that the reciprocating engine will experience a greater direct challenge than jets present to airscrews.

That this challenge means there is much to be overcome in developing the turbine is shown by history so far. Prior to RAF Air Commodore Frank Whittle's initial success—back when he was a Lieutenant—many had already worked on the problem. What passing references there were in technical literature when he filed his first patents in 1929-30 all tended to suggest the turbine had little or no future. As much as 75 percent of the power developed by the turbine was absorbed internally to drive the indispensable compressor. In other words, a unit equivalent to 8,000 hp. might deliver as little as 2,000 hp. in the form of thrust pounds.

This ratio of positive to negative work was early seized upon by critics who pessimistically argued that the work of compression (the negative work of the thermal cycle) was so large a proportion of the work done in expansion (the positive work of the cycle) as to make the unit unsuitable.

This ratio of positive to negative work is obviously of the greatest importance. Naturally, the bigger it is the better, just as in airframe design the aim is a high thrust/drag ratio. What Whittle firmly believed was that metallurgical progress would provide materials capable of withstanding much higher temperatures and thereby contribute to increased efficiency. He steadfastly refused to accept as axiomatic that the efficiencies of the two main components—compressor and turbine—could not be raised to a practical stage.

With temperatures of better than 1,200 deg. F. freely talked of, and higher temperatures definitely coming, his early aims have not only been attained but, with heat exchangers and intercoolers, bid fair to be exceeded. With the thermodynamics of the aircraft turbine under a strict veil of military secrecy, it is impossible to say how fast and how far these developments may go.

The case history provided by the almost meteoric rise of the turbine-compressor unit provides the best of arguments for maintaining an open

mind on these and other discoveries and to continue research and development, by collaboration between our two countries, of all promising schemes of this character.

Turbine-Propeller Combinations

Developments to date have brought general agreement that many aircraft of the future will have turbine power plants, but whereas jet propulsion is essentially suited to certain special forms of high-speed high-altitude types with pressurized cabins, efficiency is at its lowest point at low altitudes and low speeds, and the rate of climb (not the speed of climb) as well as takeoff, are not yet comparable to airscrew efficiencies. It is evident, therefore, that for large postwar aircraft the tendency will be to employ gas turbines driving airscrews, probably of the pusher type.

There is, in my estimation, one outstanding reason why pushers rather than tractor type airscrews may be employed on postwar aircraft. The comparatively small, simple turbine of almost cylindrical shape, devoid of excrescences and projections which inevitably create parasitic drag and airflow turbulance, is particularly convenient for enclosure within the wing or fuselage. By reason of this total enclosure of a unit of relatively small dimensions, better structural form of the aircraft can be employed to reduce the boundary layer of air or profile drag. Much of the enhanced speed which jet-propelled aircraft have demonstrated can be ascribed to the smaller, lighter, and more perfect aerodynamic structures that the compact turbine has rendered possible.

The process of joint evolution of aerodynamically perfect structures and compact turbine power units will bring still greater contributory benefits in its train and at the same time revolutionize the external appearance and dimensions of aircraft as development proceeds.

Turbines will be much more special and tailor-made to the type of aircraft under design. It is probable that the airframe designer, working in close conjunction with the turbine designer, will determine the size of the power plant; he will ask for a turbine installation of a given size and thrust power. He will not have to build his aircraft around an engine just too small or just too large.

There is also the fact that the airframe designer should be able to get his desired power plant in fairly short order. Since turbine-compressor power plant thrust output follows a geometric ratio to size, the design and production problems are greatly simplified and valuable time can be saved. Therefore, the tailor-made feature of the power plants should not greatly affect costs of the completed airplane, even on production runs which by today's standards will seem small.

This rapport between power plant and airframe designers will become a paramount issue as the speeds inherent in jet-propelled craft come out of the wartime laboratory, for they bring the aero-dynamicist slap up against boundary layer control problems.

And in any consideration of turbo-powered aircraft, the necessity for providing air intake for the turbine can be turned to advantage by arranging the air intakes to exert an influence on the boundary layer airflow.

But as a first stage in the evolution to this form of design, turbines in the early postwar era will probably be mixed with four-stroke reciprocal engines on multi-engine craft, a notion I have already advanced. The feasibility of employing four high-powered turbines on large airliners, two inboard driving airscrews and two outboard producing propulsive jets, was also envisaged. Such a combination offers certain contributory advantages both at low and high altitudes.

At extreme heights, for example, the orthodox engine tends to flag in the rarefied atmosphere and propeller efficiency falls away. On the other hand, the turbine begins to gain efficiency with increased altitude and speed. Just as the lower temperature of the atmosphere appreciably assists efficient operation of turbine-compressor units, the thinner air offers less resistance to forward speed, back pressure to the jet is reduced, and the resultant increase of speed provides a beneficial ram effect of cold air through the compressor to raise efficiency of the complete cycle of operation. A mere percentage increase in the efficiency of the compressor will result in a marked increase of efficiency in the complete cycle.

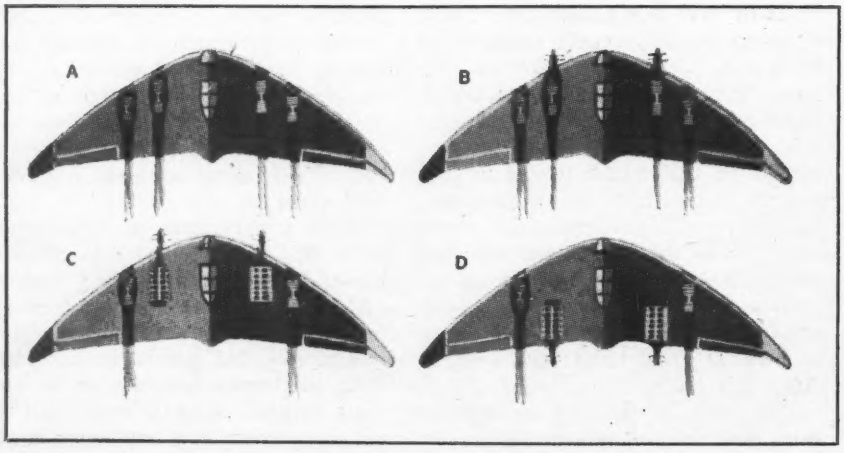
Research Essential

To attain higher compression ratios is a problem of the moment, but encouraging investigations into the possibilities of thrust augmentors and heat exchangers indicate that, as in other turbine problems, the answers will be found.

Nor does it seem that, with a continued open-minded approach by the aircraft industry, together with diligent research and development, we will have to wait as long as might be supposed for the answers. At a moment when the call is for very high-powered engines for the large airliners already being projected, the smooth, light, compact, all-rotary gas turbine assumes greater importance.

It is easier to design and produce a gas turbine of 5,000 hp. (or its equivalent in thrust) than one of 500. There are fewer unknown factors. If speeds of 500 to 600 mph. are the aim, and passengers are ready to fly in the troposphere—possibly the stratosphere—in pressurized cabins, then the turbine-jet has no match.

I confidently envisage regular trans-Atlantic crossings between dinner and breakfast, and the cost won't be outrageous to important business men. Although British engineers frequently quote ten years as the necessary development period before this era is reached, my own view is much more optimistic in line with the American thought.



Four possible power plant arrangements for flying wing suggested by author. A contains four continuous combustion turbine and axial compressor type jet propulsion units; B, two turbine-driven contra-rotating propellers, and two jet propulsion units; C, two reciprocating engines turning contra-rotating propellers, and two jet units; and D, two reciprocating engines turning pusher propellers, and two jet units. (From "Gas Turbines and Jet Propulsion," courtesy the author.)

Delegates of half a hundred nations gathered in Chicago for opening of International Civil Aviation Conference. Kia-Ngau Chang of China is at speaker's rostrum. (Press Association photo)

THIS Is Our Air Policy—So Far

Not until the Chicago Conference did the American public or aviation industry know what their government's proposals would be on this vital postwar question. Here is a digest of the salient points.

FOR THE FIRST TIME, the American public was given an inkling of what this country's international air transport policy might be like when A. A. Berle, Jr., Assistant Secretary of State, opened the International Civil Aviation Conference last month.

Since it is almost diametrically opposed to initial British views, and since Congress hasn't yet had an opportunity to consider it, the policy may well be drastically altered before ever becoming an operating force. Here, however, are the basic premises upon which this country, perforce, is attacking one of the most important of postwar questions.

The United States believes, according to Mr. Berle's statement of policy, that each nation has a right to maintain sovereignty of the air over its land and territorial waters. Consistent with that sovereignty, nations should subscribe to rules of intercourse between friendly states whereby air navigation shall be encouraged and commerce fostered between all peaceful states.

Regarding passage through the air, this government takes the view that we are in a stage calling for development of friendly permission. This friendly passage, of course, "can only be availed of, or expected by, nations which themselves are prepared to accord like privileges and permissions." Accordingly, the United States proposes "that there shall be an exchange of the needed privileges of intercourse between all friendly nations and, in such exchanges, no exclusion or discrimination against others." This right of communication, however, does not imply the "right to wander at will throughout the world;" there is at present "little place for tramp trade."

Having made public the routes for which the United States will endeavor to obtain permits, "it is prepared to discuss like permissions with other countries seeking intercoruse with the United States." This country further feels that, in addition to route agreements proposed, that there is a basis for attempting now an air navigation agreement which will modernize and make effective the rules of air navigation.

Taking a definite stand against a powerful international governing body —keystone of Britain's proposals—the policy statement declares this country "believes that international organization at this time in economic and political fields must be primarily consultative, fact-gathering, and fact-finding, with power to bring together the interested states when friction develops; with power to suggest to the countries possible measures as problems existing and unforeseen come up; and designed to set up a system of periodic conferences which may lay out and agree upon . . . the necessary rules."

The possibility of later support for a governing body with wide powers is not, however, completely ruled out, "but it would be neither statesmanlike nor practical to pretend that" the time is here yet.

This country adheres firmly to the principal of cabotage on an individual nation basis, "for if a number of countries were to combine to pool their cabotage as between each other, the result would be merely to exclude nations not parties to the pool, and it is the firm conviction of this Government that discriminatory or exclusive agreements are raw material for future conflict."

This country will make available, on non-discriminatory terms, civil transport planes to those countries which recognize "the right of friendly intercourse." Such planes will be released when the military situation permits.

Based on the assumption that "no country can expect at present to have wide-flung aviation lines without subsidies," this country "is prepared to discuss ways and means by which minimum rates can be agreed upon and by which the subsidies which are involved in all transport trade shall be used for the purpose of legitimate air communication, but not for the purpose of assisting rate wars or uneconomic competition."

To get desperately needed pilots quickly, Gen. H. H. Arnold far-sightedly turned to commercial flying school operators who not only trained cadets, but did it for less money. Now, says an outstanding operator, is the time to be sure we—

Keep Those Contract Schools Going

By EARL D. PRUDDEN
Vice-President and General Manager, Ryan School of Aeronautics

UNSTINTING PRAISE for the fighting successes of the American air forces is justifiably unanimous. John Q. Public knows his air organization is the finest in the world.

But how often does this same citizen give credit for the huge dollar-and-cents economy of this operation to any branch of our military organization, particularly the Army Air Forces?

The story of the overnight expansion of the training program of the United States Air Forces has been cited as a military saga that has no parallel. However, few persons seem to realize that in that accomplishment, commercially-operated flying schools played a role of truly vital importance.

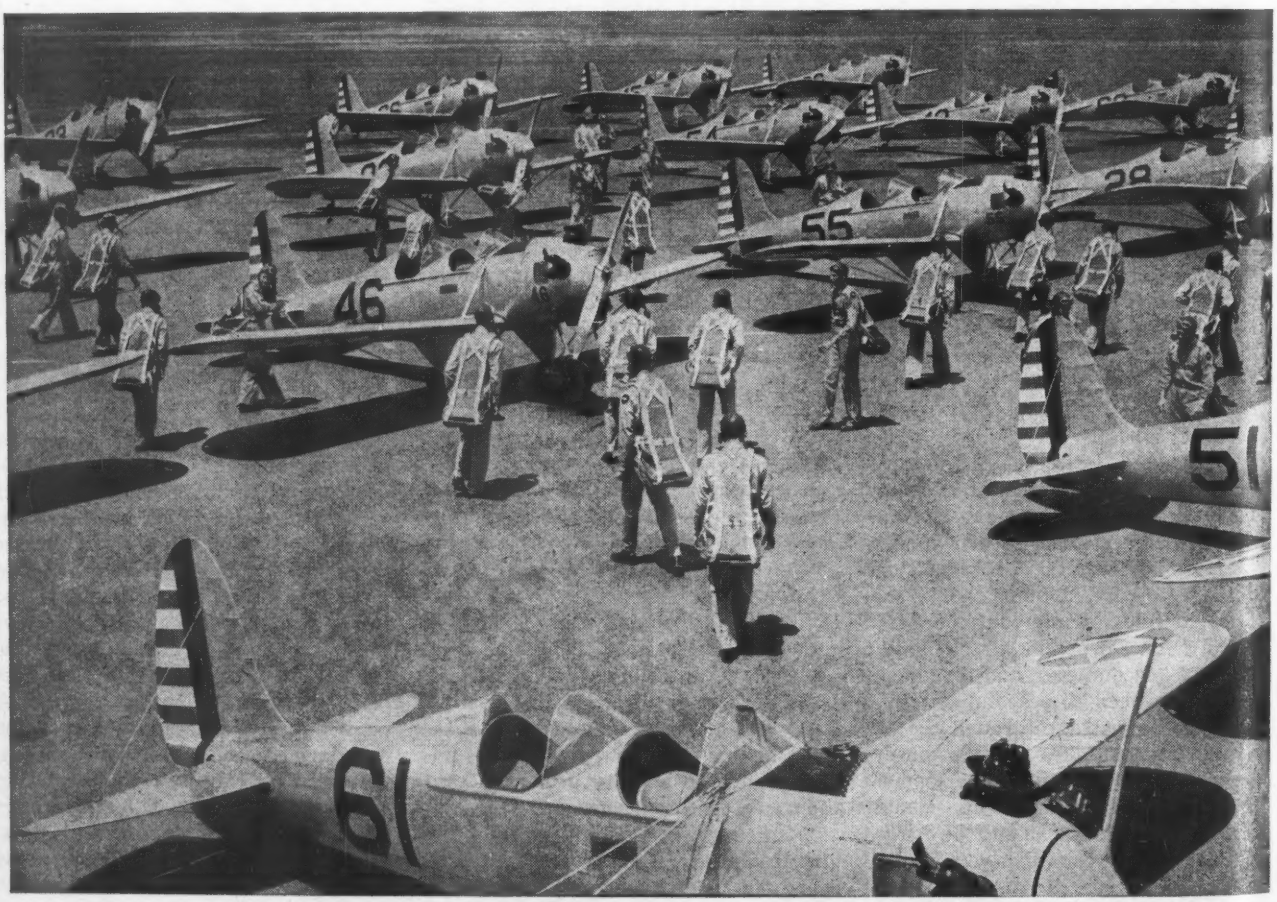
Now, when the part of these schools in this phase of the war is being reduced, is an appropriate time to review their records as a basis for establishing the desirability of continuing the program in peace time by maintaining a minimum of highly-qualified commercially operated primary schools in each of the Air Forces' three training centers.

Faced with the need for tremendous overnight expansion of pilot training in 1939, Gen. H. H. Arnold adopted the militarily unorthodox procedure of calling to his aid a group of civilian flying school operators whose commercial operations and geographical locations entitled them to consideration.

The loyal fraternization peculiar to pilots, and their steadfast faith and confidence in Gen. Arnold's ability, accomplished what would otherwise have been impossible. An enlarged AAF was an overnight reality, and the general's faith in the commercial operators, was according to military records, fully justified.

This program saw approximately 64 civilian schools, members of the Aeronautical Training Society, charged with the responsibility of giving all of

Besides saving manpower and money, civilian flight school operators training Army Air Force cadet pilots got accident rates down to an all-time low and graduation rates up to new peaks.



the primary flight and ground school instruction to the thousands of cadets who have been added to the U. S. sky forces since July 1, 1939 (when our air arm was so pitifully small).

Had failure resulted from this experiment in the use of civilian contractors for what had always been a military prerogative, there would undoubtedly have been a chorus of objectors from both military and civilian life who would have agreed that it should not have been tried in the beginning.

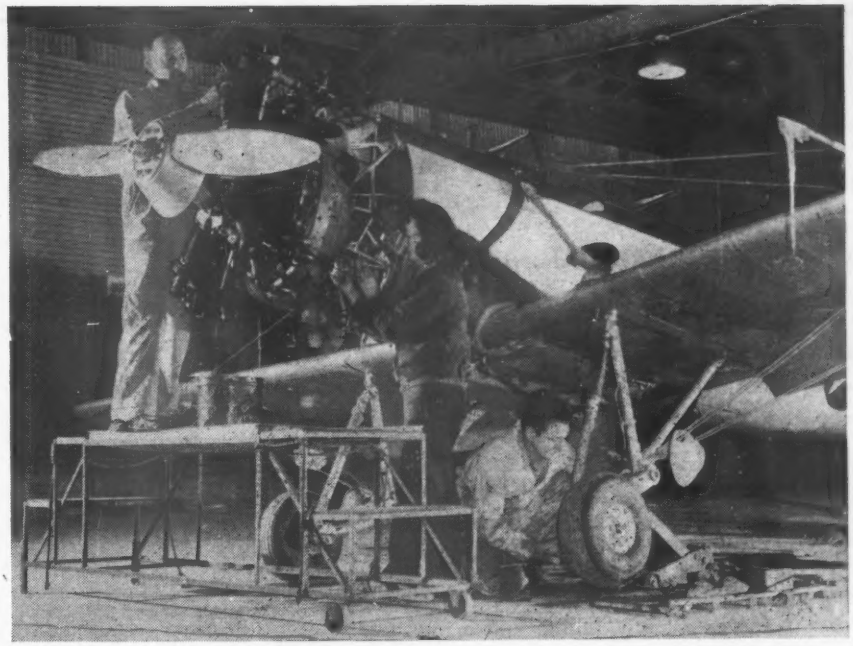
Today, however, the program is by every yardstick of accomplishment a proven success. Nevertheless, only a few voices have been raised to extend the appreciation of the taxpayer to Gen. Arnold and the Army Air Forces, or to encourage the continued use of the civilian contractor as operator of the Army Air Forces Primary Training Program.

It has been estimated that more than 100,000 military personnel were released for combat or other active military duty as a result of the civilian contractors' ability to use personnel of all ages and physical classifications without restriction by Army requirements. The close bidding for contracts and the searching scrutiny given to the training program by the Army's contract department resulted in an estimated saving of more than $250,000,000 of taxpayers' funds. This saving is far greater than total Air Forces appropriations during some prewar years.

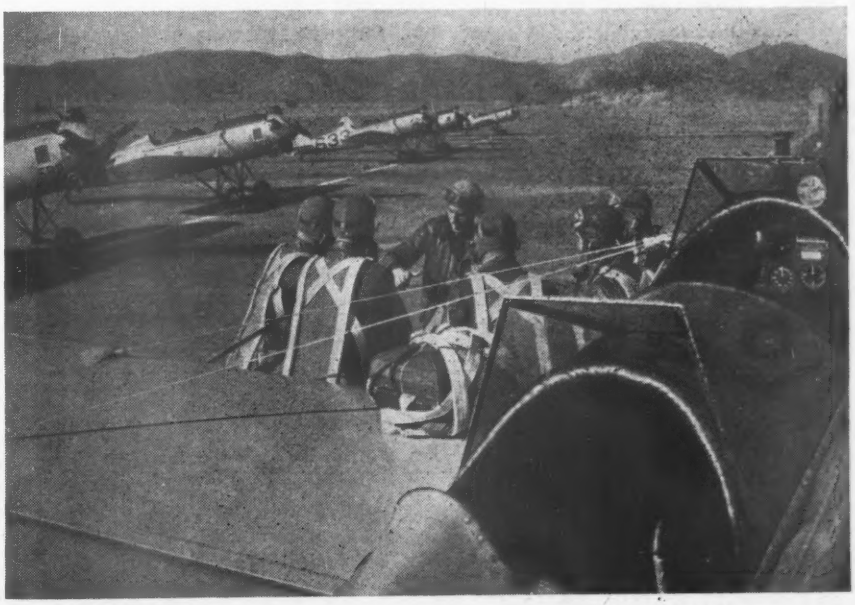
In addition to the manpower and financial saving which resulted from this precedent-breaking type of civilian-military collaboration, is the startling and gratifying fact that the accident rate for this civilian conducted activity has dropped to an all-time low and the graduation rate for cadets has attained a peak never before approached.

For a new high in efficiency and far-sighted desire to accomplish the greatest good with the least expenditure of cash, manpower, and time, American business men and taxpayers owe a vote of thanks to Gen. Arnold and his staff who, in 1939 were willing to push aside military precedent to accomplish the desired objective.

United States Senators and Congressmen, and particularly our Military Affairs Committees, will do well to study and analyze the excellent record of the 64 commercial flying schools which so capably gave the Army its primary flight training program with unexpected economies of operation. And John Q. Public can do well to express his vote of confidence in the plan by demanding a continuation of this satisfactory program in the postwar era.



Commercial contractors, using non-military personnel to train sorely-needed pilots, have saved U. S. taxpayers more than $250,000,000.



"It has been estimated that more than 100,000 military personnel were released for combat or other military duty as a result of the civilian contractors' ability to use personnel of all ages and physical classifications without restriction by Army requirements."

The use of properly qualified commercial flying training schools under the careful supervision of Army authorities can accomplish the desired results at lower cost and greater efficiency than could be equalled by a return to the former plan of military training by military personnel. At the same time it will develop a broad civilian base for immediate overnight expansion of our Air Force if necessary. This is certain to serve as a constant challenge to any nation which, in the future, may be bold enough to consider the United States as a military opponent.

Continuing the integration of these strategically located, highly developed, thoroughly tried and proven commercial flying schools into the postwar pilot training program will have many beneficial effects. Not the least of these is the continuation of a long-established, proven American idea that its military springs from and is perpetually a part of—rather than a dictator to and standing apart from—the

(*Turn to page* 262)

HERE'S YOUR LOCAL MARKET

By **FRANK S. CHRISTIAN,** *H. B. Humphrey Co.*

A practical, working plan by which dealers and distributors can accurately determine the potential volume of individual territories —together with key merchandising suggestions to insure success once the market area has been staked out.

REMEMBER NOT SO LONG AGO when the leading citizens of your city pointed out as crackpots those brave souls who proclaimed themselves to be "in the business of selling automobiles?"

Crackpots they may have been, but they were also often the smartest men in town. Thousands of those who stayed with the automobile made independent fortunes and in many cases are today themselves the leading citizens.

So it will inevitably be with the airplane. Those who devote themselves to aircraft sales and distribution will create a new generation of successful businessmen. The airplane has gone through its long years of costly trial and error, growing up almost overnight in meeting its heavy war responsibilities. The personal plane is about to take its place as an important means of transportation in America; it is no longer the toy of the playboy or the outlet for the thrill-seeking daredevil.

Common sense has come to the fore, as it always has in the development of American industry when the time has come for serious expansion.

There are those who have predicted that the air will be black with a swarm of planes bearing people no longer earth-bound. Others predict that every garage will house a helicopter. That may well be true *some day*—but it's *today* that we must concern ourselves with in aircraft distribution. We know that those who fly from, say, New York to New Orleans and then criticize the personal plane as too expensive, too slow, and not as practical as the airlines, have failed to conceive the real and logical function of the personal plane.

Precious few people use their automobiles for long trips where time or over-all expense are considered. Public transportation is still cheaper, and on long trips it is faster and more restful than the automobile. How many business men would drive from New York to Chicago, for instance? Few. The train carries them comfortably, utilizing sleeping time. Commercial airlines do the job still faster, easier, and as inexpensively.

But our personal cars are a necessity, and the day when our personal plane will take its respective place in our daily lives is near at hand. Expect the personal plane to enlarge a person's normal sphere of activity to three times that which is normal for his automobile, and you have a practical application of the utility of the personal plane. That sphere may some day become greater. But right now we're talking about *today* with planes we *know* will be available when manufacturers can again devote their efforts to making consumer goods.

Just as highways made possible the sale of 29,000,000 automobiles, airports will open up the market for personal planes. The CAA plans 3,000 more airports, to be built as quickly as possible after the war is over, to supplement the 3,000 already built. The Aeronautical Chamber of Commerce has been working vigorously on its airpark program (landing facilities in every city and town including easily seen and understood avigational markings) and with outstanding success. Word comes daily to the Chamber's Washington office of more and more towns and cities which have joined in the program. Progressive civic leaders have already started in large numbers to put their community on the nation's air map just as the highways put them on the road map.

CAA regulations which were cumbersome, and in many cases absurd, in their restrictive measures are currently undergoing changes which will eventually make the rules and regulations for the use of a personal plane as reasonable as those which today apply to the operation of an automobile.

Other things which are undergoing change to fit them for the inevitable aircraft volume market are insurance and aircraft service. In the past, both were limited in their development, but insurance companies are expecting much greater volume and they particularly recognize the technological advancements in aircraft and aircraft control.

Already planes such as the Skyfarer and the Ercoupe have been developed —both are non-spinnable craft with but a wheel and a throttle for the newcomer to master. No long hours of practiced coordination are necessary to learn to fly such planes, and volume will lower the plane's first cost.

Plane manufacturers are tooling today to build thousands, where before they built hundreds. The war has taught manufacturers the importance of designing and building planes that can be easily and quickly serviced. War has also produced thousands of trained aircraft service men, tools, and machinery.

These things are either already accomplished or are in the process of accomplishment right now—*today*.

The business of selling these thousands of planes which are being planned by the manufacturers comprises the problem which is probably the most vital of all in the movement to get for America's new huge industry the necessary volume of consumer ownership.

There are some among the ranks of prewar distributors of aircraft—the field totaled only 51 in 1940—who will

AVIATION'S widely used series titled, "Here Are Your Markets" (May, June and July AVIATION), presented basic aircraft and accessory marketing data for manufacturers, distributors, and dealers for the 48 states and the country as a whole.

With that series as a background, we are proud to present the accompanying article, specially prepared by a marketing authority to assist dealers and distributors in establishing themselves in their chosen territories on the sound basis so essential in building the true big-business operations that will be vital in the personal plane field.

—THE EDITORS

do little or nothing to fit their plans to a new, larger, fast-moving aircraft market. The great majority were those who spent most of their efforts selling rides or giving lessons and renting time. Competition did not then demand much else, and sales were a side line. However, many do realize the need for a change and will do something about it. Still others, entering the field of aircraft sales for the first time (one out of every three auto dealers report plans for aircraft dealership) will be aggressive in their thinking and planning, and will bring with them successful sales and merchandising experience.

Previously the market for the personal plane was limited by the craft's utility, which was restricted by the lack of airports, of service facilities, and of proper regulation, etc., not to mention factors of performance. This meant a financial inability to attract and pay for merchandising brains and experience.

Four Major Considerations

Let's take a look at the more important problems confronting a prospective distributor or dealer who has decided where he is going to operate. He is immediately confronted by these four major questions:

1. What plane or planes should I sell?
2. How many prospective purchasers are there in my territory, and where are they located?
3. How much of an organization do I need to adequately service my territory and make a satisfactory profit? In short, how much can I make on the business I can do?
4. How large a showroom do I need, and should it be located at the airport or downtown?

Attacking the questions in that order, consider first, "what plane or planes?" In arriving, here on these pages, at an answer to this one, we may easily appear diametrically opposed to some manufacturers' ideas, disagreeing with those who have already made up their minds. Let's, however, apply practical reasoning to the problem.

First, what groups will make up the market the first two years after the war? According to General Aircraft Corp.'s survey of "The Postwar Aircraft Market" they stack up as follows:

1. Replacement to previous owners 9%
2. Civilian pilots buying for the first time 5%
3. Returning Army and Navy personnel 24%
4. The until-now-non-flying civilian 62%

SALES SOLICITATION OUTLINE—MAIL, PHONE, AND PERSONAL CALL

Classification by type of prospect	Where to get prospects	What to mail	When to mail	When to make phone call	Personal call	How records should be kept***
1. Old account	Charge account records or ask name of cash customers	O. A. letter & brochure 1–2–3	Monthly for 3 months	After 3rd month	—	Make up cards from inactive charge accts. or when name is obtained cross reference date and alphabetical files
2. Reference prospects	Get minimum of 3 names from cash customers sold	Prospect letters 1–2–3 & brochure	Semi-weekly for 3 mailings	One week after 3rd mailing	—	Make up cards as soon as name is obtained and file as above
3. Interested people visiting airport or show room	Ask name or take license no. of car or plane*	Prospect letters 1–2 & brochure	Semi-weekly for 2 mailings	—	5 days after 2nd mailing	Same as #2
4. Service dept., gas, shop, service inspection	Name and address from sales ticket or plane license**	Service letter—prospect letter #1	Semi-weekly, 2 mailings	—	5 days after 2nd mailing	Same as #2
5. High rental area residents	Street directory & rental map or auto registration lists	Prospect letters 1–2–3	Semi-weekly, 3 mailings	One week after 3rd mailing	—	Make up the number of cards that can be properly handled daily and file as other classifications
6. Executives of local businesses	Chamber of Commerce or direct inquiry	Prospect letters 1–2	Semi-weekly, 2 mailings	—	One week after 2nd mailing	Same as #5

* License number can be looked up in state automobile registration list which also contains name and address or, if plane, CAA registration list.

** Service and sales tickets, if provided with space to note future needs of customer, can be a great help in follow-up for future business, and information from sales tickets should be transferred to file card.

*** Prospect cards in duplicate should be made out, with first mailing made on classification 2, 3, & 4 as soon as name and address has been obtained, one card filed alphabetically, the other in a 1–31 date file. A systematic coverage — a given number each day — should be made on classification 5 & 6. The 1 (old accounts) should be set up in prospect file as soon as the account becomes inactive.

Prior to the war there were approximately 25,000 non-military planes in the United States. Only 30 percent—some 7,500—were "privately" owned, applying the term as we do with the automobile. The rest were owned by fixed base operators, airlines, corporations, and flying clubs. Obviously, this cannot be the basis for a big new market, and the planes these latter groups will buy will parallel their experienced need. This may, in many cases, mean more expensive, faster, and "hotter" airplanes than the less-experienced will want.

Naturally the other experienced pilots and those with military training will fall into the classification of being able to handle a plane necessitating highly developed skill in the art of flying. But here we encounter a likelihood that price will be a more important factor.

Usually, the prewar owner paid out more for the plane and its upkeep than the average person would nominally pay for a means of transportation. This is further evidenced by the number of people who gave up flying because they found it too expensive. According to the CAA, students accounted for 56.6 percent; owners, 50 percent.

The returning military airman will have the task of re-adjusting himself to civilian life. That includes getting a job, a home, furniture, a car, and possibly starting to raise a family. All these things will take considerable money, and it is probable that the average man will rent a plane before he buys.

His mental and physical adjustment to flight, however, will make him a good prospect, and it has been estimated that he will represent 24 percent of the potential market. Some 85 percent of the pilots have indicated they want to own planes, but most have said they will buy other things first. It is interesting and understandable that combat experience lowers considerably the pilot's enthusiasm for owning his own plane, making logical the estimate that only 10 percent will be prospects in the first two postwar years.

Thus far we have looked at the size of three of the four classifications in the potential market. They make up 38 percent of the total estimated market.

In picking a plane to satisfy them, ease of control and safety will not be a major factor. These features will, however, be the most important to 5 percent. For the remainder, the more important features will be speed, range, comfort, appearance, and equipment, and there will be no necessity for teaching them to fly. Thus the plane characteristics for the dealer to seek would be favorable speed (100–125 mph. honest cruising); a good utility range (500–700 mi.); comfort (high quality appointments and equipment); ease of control; and unquestioned safety features (non-spinnable, positive glide path control, good visibility, and a really good steerable-on-the-ground tricycle landing gear).

Now let's look at the other 62 percent of the prospective market, the until-now-non-flying civilian. Limiting prospects to those with incomes of more than $2,500 per year, we find, according to the National Resources Planning Committee and OPA, that in 1942 there were 13,104,000 consumer units in this group. Applying a shrinkage figure, in anticipation of the war's end, of 25 percent (which conservatives believe probable), we still have approximately 10,000,000. Of this number, those indicating an intention of buying a plane before making any other major purchase total 1 percent.

For the early market it is this group of some 100,000 around whom plans should be built. To this group ease of control; inherent safety; comfort; price; appointments; cruising range; and speed are ranked in importance in that order. Since ease of control ranks first, it is obvious that simplified controls, such as those found in the Skyfarer, Ercoupe, and others on the boards, will prove an important factor. Both these planes have reduced CAA dual and solo time (5 hr. dual instead of 8; 25 hr. instead of 35 solo) which means less expense in teaching the prospect or purchaser to fly, with a corresponding reduction in sales resistance. And in the matter of safety, it has been found that 53 percent of the civilian preference has been based on that factor and ease of control. It is therefore logical to sell a plane meeting these requirements.

Since price is important, and the plane's size and number of seats has a bearing on price, it is reliably estimated in the industry that the two-place type will meet the demand for 70 percent of the market. "Must" features for the now-non-flying civilian, however, will include such conveniences as radio, light, heat, glare control, and self starters; for this man won't want to pull a prop through, and his wife will want to even less.

A four- or five-place plane will be a logical addition to the distributor's line. Although it is believed that less than 5 percent of the total market will be for these types, they will nevertheless be important in dollar volume and also in the prestige in servicing these "limousine" customers.

Next comes the problem: "How many prospects are there in my territory, and where are they located?"

From the local American Legion Post or, possibly, from draft boards, the number of service airmen from your territory can be determined. Then apply the 10 percent—the national average of that group found to be prospects. Next, from CAA can be determined the number of registered owners and licensed pilots in your territory, to which should be applied 20 percent—the national average expectancy.

Then, to the remaining non-flying

(*Turn to page 277*)

Sales Operating Budget

	Sales Estimated This Month	Estimated Gross Profit %	Estimated Gross Profit	Actual Gross Profit Year to Date	Actual % Gross Profit Year to Date
Sales:					
1. New planes					
2. Parts, accessories, and supplies					
3. Used planes					
4. Service					
5. Other sales					
Totals					

	Estimated This Month	% to Sales	Actual Year to Date	% to Sales
Expenses:				
1. Salaries				
2. Advertising				
3. Travel and sales expense				
4. Light and heat				
5. Rent				
6. Office supplies, etc.				
7. Shop, equipment, and supplies				
8. Other expenses				
Totals				

	Estimated This Month	% to Sales	Actual Year to Date	% to Sales
Gross profit				
Operating expense				
Net operating profit				

Hang Your Shirt On a Star

Alert clothing manufacturers name their sports-wear Cavu and tie promotion to flying. What's more they put airplanes to work in long-range sales program.

USE OF AIRPLANES to promote the sale of many kinds of merchandise is not a thing of the past. Planes can, as a matter of fact, be used not only for promotion purposes, but as an integral, working factor in the over-all sales program.

One organization, for example, has already put two radio-equipped Stinson 105's to work, and it plans to put other planes in service as conditions permit the development of additional business.

It all began some time ago when M. M. Brohard, Jr., Cincinnati clothing designer and manufacturer, took up flying as a sport. He wanted a shirt that was not only distinctive but comfortable for long cross country flights, so he designed one and had it made up.

Chief Pilot Carl Ogden (left) and William G. Brohard unload samples of Cavu sports clothes on sales trip in one of company's two Stinson 105's. Brohard brothers have not only designed their clothes "with a flair for the air" as promotional program but have also put planes to work for sales and delivery.

Flying salesman Carl Ogden models Cavu "Tailspin" shirt in front of radio-equipped company Stinson. As materials and plant capacity permit increased production, his duties will include flight training—where necessary—and also teaching new salesmen how to use plane in merchandising.

It proved very popular with his fellow flyers, but making more for them was impossible due to pressure of the company's war contracts. As these contracts were completed, however, and limited quantities of material became available, special orders were filled. The business possibilities became more and more evident.

Brohard's interest in flying meant but one thing: The business would have a close connection with aviation —and from a modest start he and his brother William (also a flyer) have developed their line of Cavu clothes, "sports-wear with a flair for the air." The line thus far embraces high grade specially designed sport shirts and slacks for both men and women, with all styles named after airplane maneuvers such as the "Chandelle" and "Lazy Eight" shirts for men and corresponding "De-icer" models for women. Quite naturally all advertising and promotion literature is designed around flying activities; even the trade-mark embodies an airplane.

More important from the aircraft industry standpoint, however, is Cavu's actual, practical use of airplanes and flyers.

First flyer to join the organization was Carl R. Ogden, veteran WTS instructor, who has been made chief pilot. His duties are not, however, limited merely to flying; rather he is becoming a flying salesman.

As materials and plant capacity become available, other salesmen—who will also have to be flyers—will be added. Ogden's duties then will include two kinds of teaching: Flight training where necessary, and instructing new salesmen how to use the airplane as a sales aid. One of the pres-

(*Turn to page* 261)

New Protection
FOR A VITAL SPOT

WELL-DRESSED aerial gunners now wear this new flexible flak helmet. A multitude of small metal squares provides extra protection for head and neck, and sponge rubber lining reduces shock and concussion.

Successful records of "missions accomplished" depend not only on the marksmanship of well-protected gunners, but on faultless engine performance assured by *effective* lubrication.

That is why, for thousands of engines in military planes as well as in the ships of civilian airlines, *Texaco Aircraft Engine Oil* is used for reliable and economical operation.

In fact . . .

More revenue airline miles in the U. S. are flown with Texaco than with any other brand.

A Texaco representative will gladly cooperate in selecting the most suitable fuel and lubricants for your particular operations. We will also be glad to furnish information for the improvement of operation and maintenance practices. The Texas Company, *Aviation Division,* 135 East 42nd Street, New York 17, N. Y.

TEXACO

TEXACO Lubricants and Fuels
FOR THE AVIATION INDUSTRY

TUNE IN THE TEXACO STAR THEATRE WITH JAMES MELTON SUNDAY NIGHTS ★ METROPOLITAN OPERA BROADCASTS SATURDAY AFTERNOONS

AVIATION'S 8th Annual Maintenance Issue

TABLE OF CONTENTS FOR SPECIAL SECTION

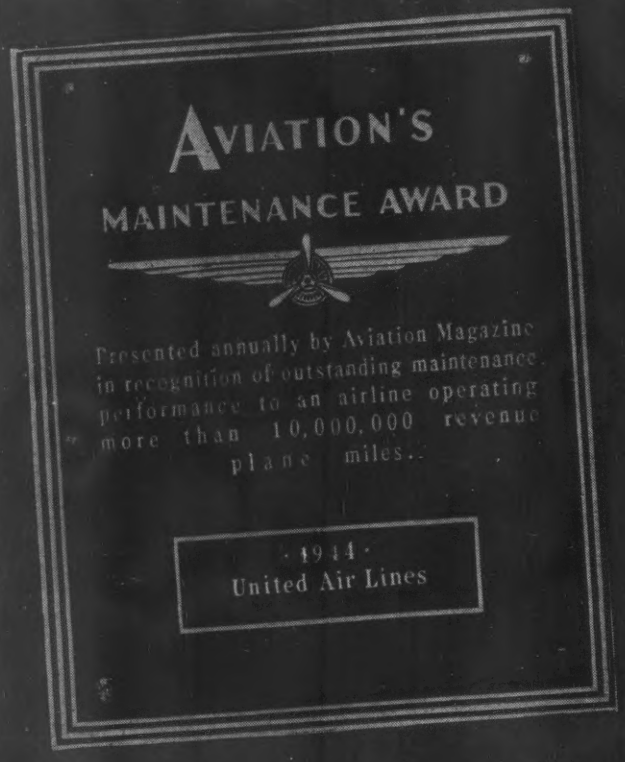
Aviation's Maintenance Awards **128-129**
To United Airlines 128
To Chicago & Southern Air Lines 129

Special Maintenance Feature Articles **130-152**
Supercharged Harness Cures Ignition Troubles ..... *Edward E. Thorp* 130
Prospectus for Postwar Service ..... *Reagan C. Stunkel* 132
More Seats Up . . . More Costs Down 135
Standardized Maintenance Means More Fixed Base Business ..... *C. C. Moseley* 136
Attaining Bearing Cleanliness ..... *Hudson T. Morton* 138
TWA Gets Double Benefits From Shop-Built Mockups 141
IF You Can't Buy It, Build It—Better ..... *George Warde* 144
It's What You Do *Before* It Snows 146
Service SNAFU Nipped in the Bud 149
Fix-It School on Wheels ..... *Wm. J. Hargest* 152

★ ★ ★

Aviation's Maintenance Notebook **155-169**
Special Sling Handles Both Engines and Nacelle 155
DC-3 Strut Checker Simplifies Procedure 156
Special Bench Speeds Cowl Flap Repair 156
One Man Handles This Simplified Brake Bleeder 157
Gas Truck Hose Winder Features Braced Crank 158
Hinged Holder Prevents Cord-Plug Troubles 158
Guard Protects Operator From Falling Loads 159
Nuts Employed in Stud Removal 160
New Plastic Runway Light Extends Above Snow Level 160
Artificial Horizon Tester Checks Time and Pressure 160
Portable Pre-Oiler Rig "Doubles" for Pressure Work 161
Oil Filter Screen Roller Expedites Repair Work 161
Conduit Winder Brings Economies 162
Router Caliper Prevents Mistakes 162
Special Scoresby Tests Gyro Horizon or Bank & Turn 163
Valve Refacer Has Special Features 163
Engine-Cowling Bench Aids in Riveting 164
Grommet Stretcher Speeds Production 164
Soviets Use Truck Rig As Starting Booster 165
Rubber-Stretching Jimmy Saves Hands 165
Shock-Strut Oiler Bleeds and Fills at Once 166
Hammer Attachment for Right-Angle Riveting 166
G. I. Sergeant Builds Time-Saving Tire Remover 167
Simple Dial Unit Checks Bearings 167
DC-3 Heater Mockup Simplifies Instruction 168
Coiler Device Makes Odd-Size Springs 168
Special Sorter Saves 17,000 Rivets Hourly 168
Oil Radiator Washer Banishes Foreign Matter 169
Rivet Remover Is Handy Tool 169
How Taps Are Saved by Plastic Extension 169

AVIATION'S *MAINTENANCE*


AVIATION'S
MAINTENANCE AWARD
Presented annually by Aviation Magazine in recognition of outstanding maintenance performance to an airline operating more than 10,000,000 revenue plane miles.
· 1944 ·
United Air Lines

AVIATION'S
MAINTENANCE AWARD
Presented annually by Aviation Magazine in recognition of outstanding maintenance performance to an airline operating less than 10,000,000 revenue plane miles.
· 1944 ·
Chicago and Southern Air Lines

"In recognition of outstanding maintenance performance and developments" during the year just closing, Aviation is proud to make its award

For the airline operating more than 10,000,000 plane miles to

UNITED AIR LINES

whose coast - to - coast maintenance department headed by William P. Hoare has established a notable record of efficiency and economy; and

For the airline operating less than 10,000,000 plane miles to

CHICAGO & SOUTHERN AIR LINES

whose Great Lakes - to - the - Gulf maintenance department headed by R. L. Anderson has likewise conducted its operations at new peaks of efficiency

★

Aviation makes these awards, based on the unanimous decision of the judges, with the full knowledge that* EVERY *airline in America has done an exceptionally fine job throughout the year, a job which free American enterprise and competition will keep at levels that will insure continued United States preeminence in air transportation.

★

AWARDS FOR 1944 ★ ★ ★

W. P. HOARE

R. L. ANDERSON

Supercharged Harness
CURBS IGNITION TROUBLES

By **EDWARD E. THORP,** *Assistant Editor, "Aviation"*

Altitude- and fog-proof ignition harness, created by the maintenance department of Chicago & Southern, is so successful that other airlines have put C & S in the manufacturing business.

CHANGING ATMOSPHERIC and pressure conditions, combined, make the ignition maintenance man's work a continuous battle against infiltration of moisture into the harness system, with the attendant evils of rough engine operation and rapid depreciation of material.

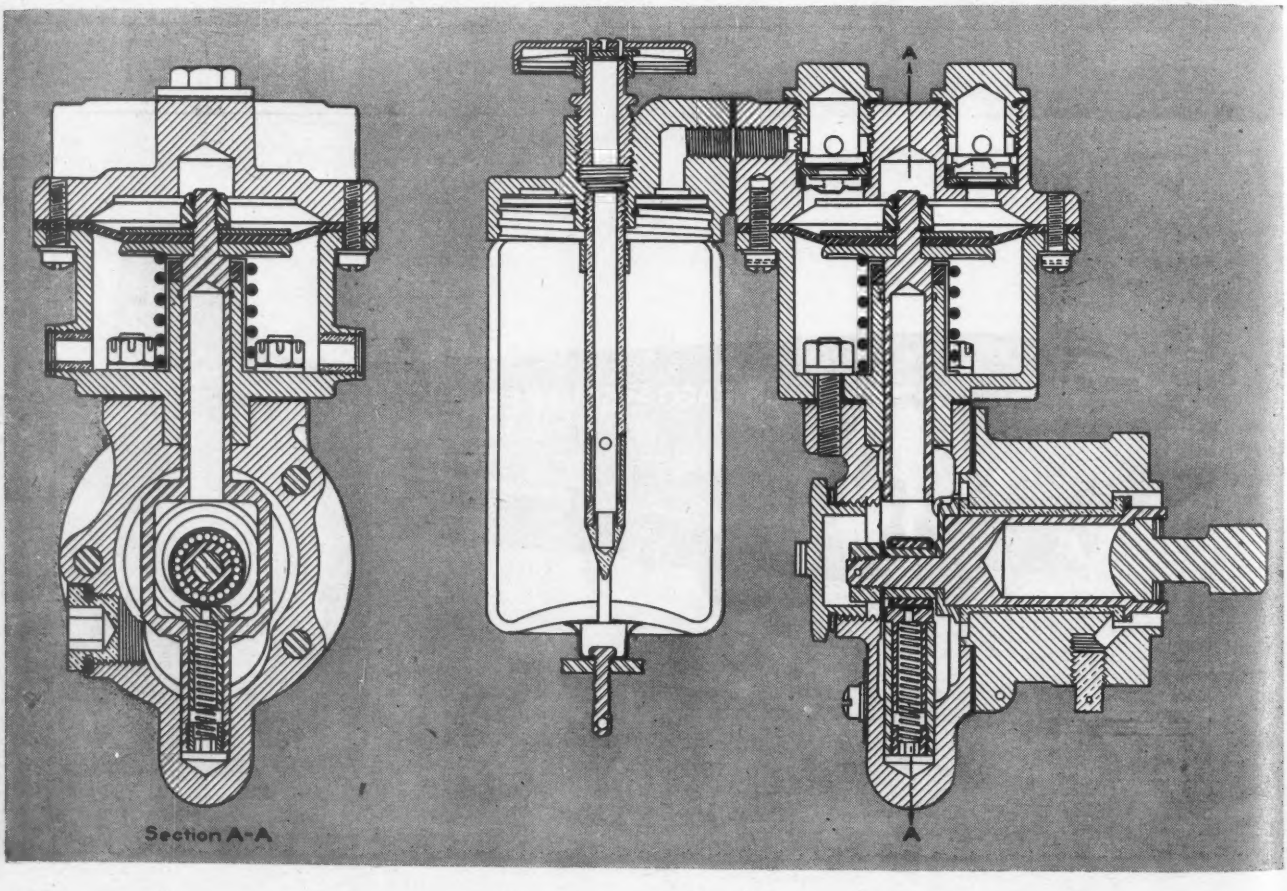
Owing to the practical impossibility of maintaining the harness and shielding in a permanently tight condition, some method had to be devised which would prevent atmospheric moisture and sparkplug leakage from interfering with smooth operation of the ignition system.

Engine manufacturers recommended drilling drainage holes in the lower parts of the shield manifolds and filling the connector wells of the sparkplugs with sealing compound. Wire makers advocated stripping the lacquer from that portion of the wire which extended from the sparkplug elbow seal grommet down into the connector well. Plug experts reduced service time to 25 hr. and the plugs were regapped at more frequent intervals to lower the necessary voltage and reduce the loading on the insulation.

But even after all these things had been tried the best that could be said was that ignition was "fair".

Attempting to better these conditions, engineers of Chicago & Southern Air Lines adopted stainless steel braid for the metal hose formerly used, and the grommets between the main manifold and the leads were eliminated, to

Air pump designed by C & S for ignition supercharging. View at left shows ball bearing on crank, which pushes pump rod downwards by pressure on spring plunger beneath shaft. Heavy spring at top raises diaphragm, forcing air into system until air pressure equals that of spring. Air is drawn into pump through glass container which is filled with silica gel. Chamber below diaphragm may be connected to supercharger pressure to provide variable pressure at that point, thus permitting air pressure in system to be varied while running.



provide better internal circulation. A special double-coned Neoprene grommet $\frac{7}{8}$ in. long was fitted at the sparkplug elbow to provide a positive moisture seal. These were installed on various makes of sparkplug, with Bakelite or ceramic connector terminals and were service-tested over a period of 18 mo. Result: Ignition was reported as "fair to good" which, in airline work, is still not good enough.

Engines ran well under dry conditions but became rough in operation during extreme precipitation, resuming normal running after they had left the precipitation area. Investigation showed that most of the moisture was caused by condensation of exhaust gas leakage through the sparkplugs. Therefore, by way of experimentation, the plug connector was sealed so that the gases would accumulate and build up a pressure which would prevent further leakage.

However, another trouble immediately showed up. Gas leaked along the center of the wires between the strands, sometimes traveling as far as the magneto itself. After this, the attempt to seal the plug connector was given up as impractical.

A survey of other airlines showed C & S engineers that they were not alone in their troubles—for practically everyone was plagued in the same way, except Northwest Airlines, which used a supercharged harness developed by Carl E. Swanson, chief electrical engineer (see page 209, Jan. '44 AVIATION). This installation, having given over 5,000,000 engine miles without trouble, was checked with the intention of adapting it to C & S equipment.

Owing to the fact that no accessory drive was available for the air pump, as was the case with NWA, C & S designers found it necessary to produce a pump of their own, one which could be driven from the machine gun synchronizer on their Cyclone engines.

As illustrated in our initial drawing, the pump consists of a diaphragm, above which is the pump chamber, fitted with plastic disk intake and outlet valves (the intake valve is at the left in the drawing). It takes air from the glass container filled with silica gel, which removes the moisture before the air reaches the pump. Air enters the dryer through a dust trap at the top, travels down the center tube, and passes upwards through the silica gel. This substance is white when dry and becomes blue if wet, thus affording a simple visual check of its condition. It may be dried by heating and used many times over. The container is an ordinary glass jar screwed into the top casting and held in position by a wire bridle passing beneath it.

Upward movement of the diaphragm is given by a large spring (shown directly beneath it). In addition to providing motion, this spring regulates the pressure of the air in the harness, variation of the strength of the spring causing a change of pressure in the delivered air.

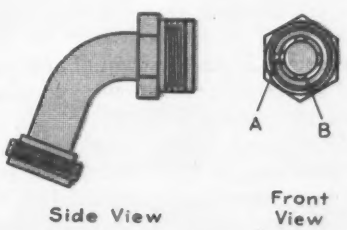
Downward or suction stroke is by crank action, cushioned by the coil spring (shown at the lower end of the pump rod). Though pounding might be expected from this design, it has been found thoroughly satisfactory in practice and very silent in operation. Apparently any slight clearance is taken care of by the cushioning effect of the oil.

It has been found advisable to fit an individual air pump and air dryer to each engine, in order to simplify the design and eliminate cross connections.

Results have been most satisfactory. Sparkplug servicing periods have been extended to 375 hr., while rough engine reports have practically disappeared. Whereas formerly up to six engines per month were reported running rough from ignition harness condensation, only three such cases have been turned in during the past year, each being due to loss of air pressure in the harness through mechanical failure. One case was caused by a broken diaphragm, another by a cracked air line, and the third involved a fractured sparkplug tube.

With revisions to the harness, the total weight addition to each engine is 6.5 lb., which includes cockpit instrumentation.

Sparkplug service time between gapping periods has been increased even though the erosion rate has not been decreased, because engines now



Sparkplug connector depicted here in drafting views, was changed by addition of four notches (A), 1/32-in. deep in face of connector flange to permit metered leakage at connection, thus eliminating exhaust gas leaking into wiring. Notches (B) are 1/16-in. deep to allow dry air to reach sparkplug well.

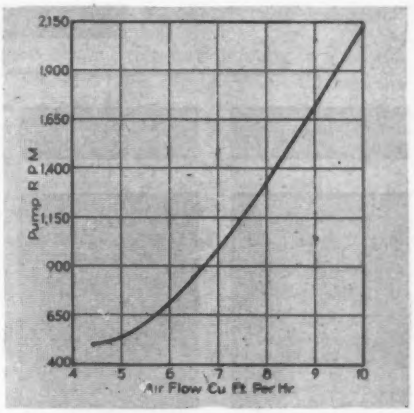


Chart illustrating output of pump at different speeds.

operate up to .028 gap where they formerly were held down to .022 in order to keep sparking voltages down to a minimum. Cases have been known where sparkplugs have operated perfectly with gaps up to .032, due to elimination of humidity and increased flash-over resistance from higher air pressure in the harness.

Overhaul of standard ignition harness requires slightly less work than the supercharged type, but this is chiefly because pump overhaul is added to the normal amount of work required. Offsetting this is the economy in wire, over 80 percent of the wire in supercharged harnesses now being on its third engine overhaul run and still in good condition, whereas in standard harnesses complete wire change is the rule at every engine overhaul and sometimes much more frequently.

Operating service costs are greatly reduced by the considerably smaller number of sparkplugs sent through for reconditioning, in addition to the considerably fewer hours of service lost through the airplane being delayed or laid over.

Moisture troubles have been entirely eliminated, since the internal pressure causes all leaks to be outwards, thus preventing entry of any external air, oil, or moisture.

The purposely created and metered leakage at the sparkplug connection passes a volume of air so much greater than any possible plug leakage that any gases passing upwards through the plug are diluted and then removed before condensation is possible. For the same reason, discoloration of the sparkplug barrel—caused by leakage of acidulated air—has disappeared entirely since adoption of the supercharged harness.

At high altitudes, where moisture is

(*Turn to page* 287)

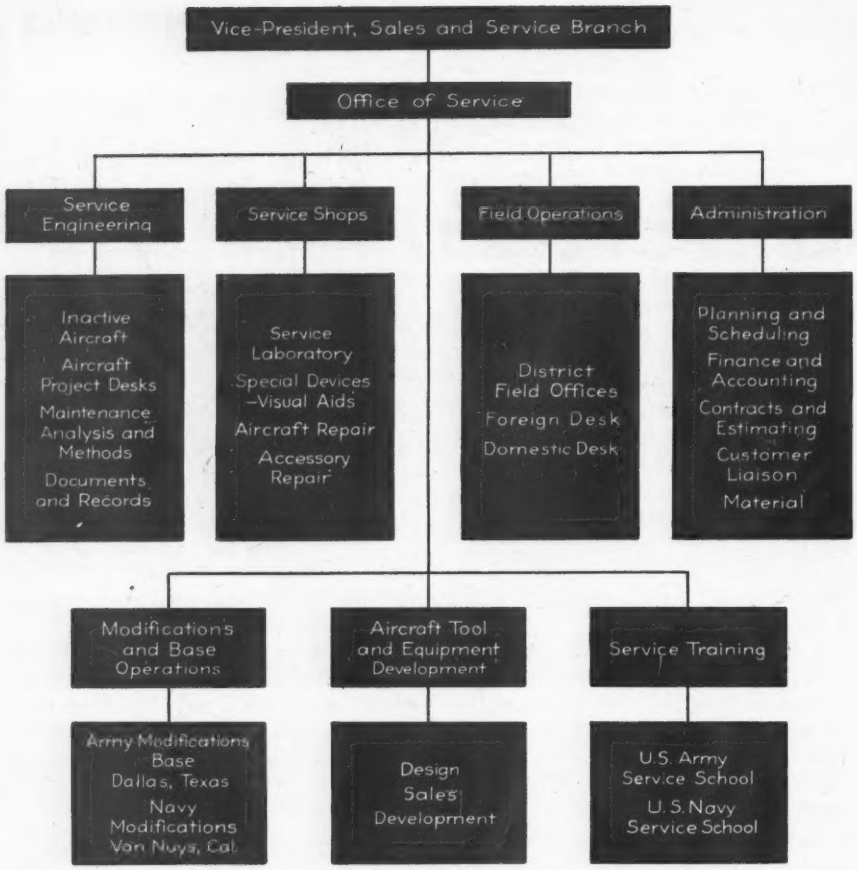


Fig. 1. Lockheed delegates full service authority to Office of Service, as shown by organization chart. Note that, in addition to normal service organization functions, Lockheed's set-up covers tool and equipment design, modification, and engineering for aircraft on which production schedules have been completed.

PROSPECTUS FOR *Postwar Service*

By REAGAN C. STUNKEL, *General Service Manager, Lockheed Aircraft Corp.*

Here's a blueprint for a flexible system whereby manufacturers can insure maintenance to guarantee highest aircraft utilization to their customers—military, airline, and private owners.

TO ATTEMPT TO FORECAST the transition from war time service operations to postwar service operations in a large manufacturing organization is to tread on the threshold of conjecture. The nature and the amount of service to be required from a manufacturer by the purchaser of an airplane must be dependent upon a great number of factors, few of which have emerged from the postwar aviation planners in the form of definite programs.

Some of these factors: 1, The international aviation policies of the nation; 2. the determination of "feeder line" operations; 3. new CAB policies with regard to operations and maintenance; 4. aircraft released for reconversion; 5. development of new airlines and freight operations; and 6, requirements of the military.

These points encompassed most of the problems of the industry, but service is so inextricably involved in the final determination of each of these factors, plus many more, that the *actual institution* of service policies must follow the formulation of basic aviation policy for the nation.

It is not difficult, however, to visualize the optimum organization required for a manufacturer's complete postwar service operation on a strictly theoretical basis. From these analyses may then be extracted those functions actually required when the occasion arises.

Before delving too deeply into the future, it is perhaps best to furnish a basis of comparison by considering a present-day service organization and its operations.

Lockheed Aircraft Corp. delegates full responsibility for the service of the aircraft it builds to its Office of Service. The present functional organization of this office at Lockheed is shown in the chart in Fig. 1. This service organization reports to the sales branch under Carl B. Squier, vice president of sales and service.

It is interesting to note that, in addition to the functions normally assumed by a service organization, the additional responsibilities of tool and equipment design, aircraft modification, and the engineering of "inactive" aircraft, or aircraft out of production, are delegated to the office of service.

Present operations of Lockheed's service organization include: The customer service division; AAF modification center at Dallas, Texas; Navy modification, repair and overhaul base at Van Nuys, Calif.; U. S. Army service school, and U. S. Navy service school. Other services are extended through Lockheed Aircraft Overseas Corp. which is operating bases in the United Kingdom.

The present service organization functions primarily for the benefit of the armed services, and it will continue to do so until the war is won.

Process of converting from wartime to peacetime service operations must necessarily take place over a relatively long period of time. There are new military models in process of development which will require the continued assistance of the manufacturer when hostilities cease, but until that time, the manufacturer must continue to supply service in the degree required by the armed forces. It is logical to suppose that the transfer of service activities from wartime duties to the commercial phases of aviation may begin with the defeat of Germany and may be complete shortly after the defeat of Japan.

Modification of service operations—

from the set-up in Fig. 1 to the theoretical set-up in Fig. 2—would therefore not be abrupt but would be adjusted entirely in accordance with the progress of the war. When this transition is complete, the problem then resolves itself into supplying *two* types of service—that required by the military in peace time, and that required by commercial operators. Fig. 2 shows the functions required to accomplish this objective.

A brief analysis of each of the functions shown on the chart will serve to explain the reasoning underlying the development of the chart.

Service Shops

The company's service organization is unique in that it has always operated a complete repair and overhaul service at the factory for the customers. This activity was extended at the beginning of the war to include the establishment and operation of complete repair and overhaul facilities for the USAAF for work overseas on all types of American-built aircraft and aircraft equipment.

One result of these operations has been the collection of a group of personnel familiar with all phases of aircraft service and repair, thus alleviating any possible limitation to the reconditioning of airframes only at the factory. This personnel now occupies places of responsibility in Lockheed-operated bases and will form the nucleus of a new completely integrated, expertly staffed, postwar repair and overhaul activity for the benefit of the customers.

Services to be offered by these shops will be: 1. Repair and overhaul of private aircraft; 2. contract overhaul of airline aircraft; 3. reconversion of aircraft to commercial types; 4. conduct of laboratory activities to determine better service methods; and 5. manufacture of visual aids, training devices and specialized service equipment.

Since the range of aircraft to be handled in these facilities varies from the small personal aircraft to the largest four-engine airliner, planning of shop operations becomes a more complex problem than that encountered either in the airline shop which services one type or the private service station servicing only small aircraft. Again, the overseas operation of the corporation serves in good stead, since the experience gained in servicing 33 types of all manufacturers was developed around a problem identical to that now confronting us. It will not be Lockheed's future policy, however, to handle aircraft other than those manufactured by it when these plans are applied.

Service Engineering

One of the major problems confronting the manufacturer in the immediate postwar era is the reconversion of military aircraft to privately owned, corporation, or airline types.

Engineering personnel presently used in modification activities have become adept through experience in this type of work, and their transition to design of commercial interiors will not be difficult. In the case of the aircraft originally designed as transport types, such as the C-57 and C-60 Lodestar, engineering already developed will suffice for the reconversion. This will not be true of the military types, such as the A-28 and A-29 Hudsons and B-34 Ventura. Achievement of any degree of economic usefulness from these aircraft as commercial models will require a considerable expenditure of engineering time and effort. The responsibility for this activity is a service engineering problem.

With the beginning of new manufacturing programs concerned with advanced types of military and commercial aircraft, models now out of production no longer receive attention from the engineering branch since the entire efforts of that organization must be directed toward new design. Hence the responsibility for continuation of customer liaison, service bulletin work, and maintenance of data on a model out of production is transferred to service engineering upon completion of a contract for the aircraft.

The 194? chart in Fig. 2 shows a division of the aircraft project desks into military and commercial desks. The responsibility of this phase of service engineering is as follows: Analysis and reply to all customer complaints; analysis and transmission to engineering of all service trouble reports from all sources; supply of technical information on service to the customer; maintenance of trouble frequency reports; field engineering investigation of troubles; and advice to

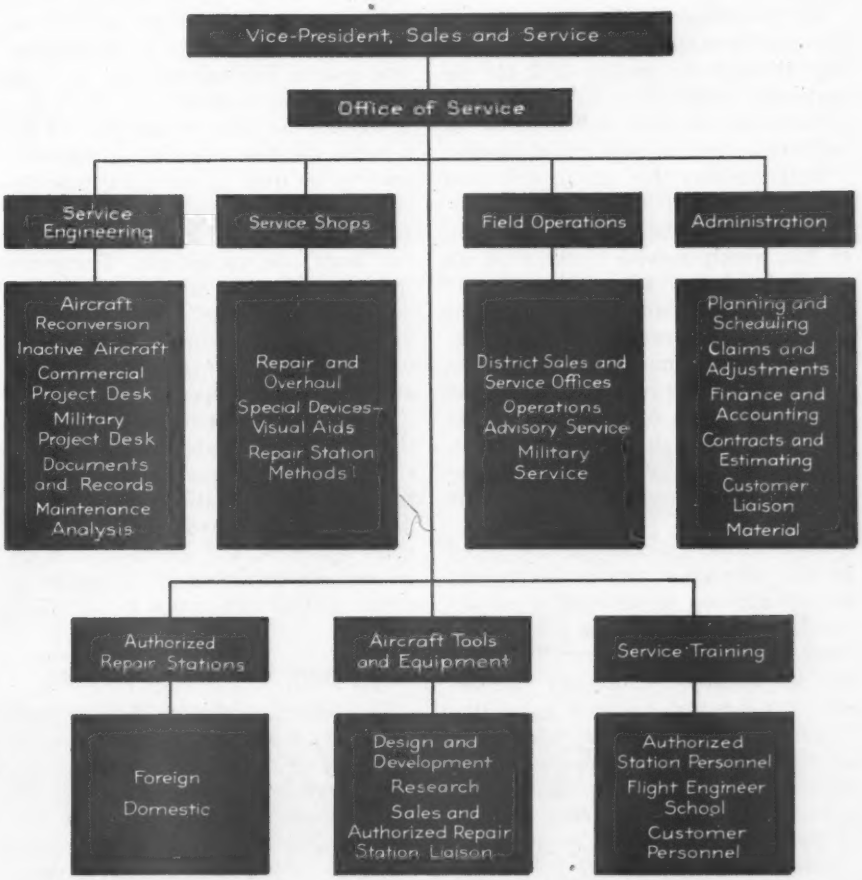
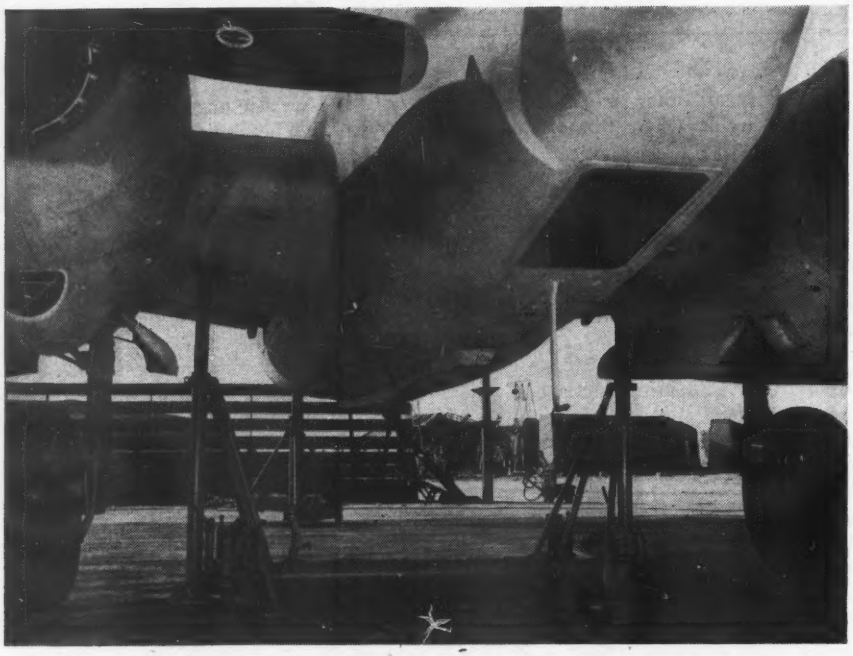


Fig. 2. Service organization chart for 194? following transition from war to peacetime operations when two types of service—military and commercial—will be required. Transition need not be abrupt, but would be adjusted according to progress and demands of war.



Lockheed service program includes tool and equipment design and production, such as represented by typical ground handling equipment shown here. As number of types of aircraft increase and use spreads, this function assumes greater importance in program designed for greater aircraft utilization.

engineering regarding correction of troubles.

All incoming and outgoing reports and correspondence from the customer flow through the project desk for the particular model affected. This system of operation obviously will function for military as well as commercial models.

Responsibility for the distribution of service manuals, bulletins, and technical operating data, also preparation of the weekly service circular on all types of company aircraft, is assigned to the documents-and-records group of the service engineering organization. It is extremely important in commercial operations to retain complete and accurate record of conformance to service bulletins, aircraft specifications, changes in equipment, and also to retain all such records in up-to-date form.

Requests have recently been received by the company's service department for information on aircraft manufactured in 1933. With the numbers of models and quantity of aircraft in commercial operation constantly increasing, this function assumes a position of growing importance in the general operation of a service organization. Maintenance of accurate service records is a necessary adjunct to most of the other branches of service.

Still another function of service engineering is the work of the maintenance analysis group, which has the responsibility of determining the best procedures, shop layouts, inventories of parts, and methods to conduct any aircraft operation. As an example of its work, this group recently assisted the Army in establishing a production-line system for maintenance of P-38 aircraft. The postwar function of this group will be, first, to analyze and determine the best methods of maintenance to be used in operating new designs. These methods are then tested in the company's own service shop and the "bugs" are worked out. The group then imparts this information to the customers' personnel through the service training department or by actual on-the-spot instruction and assistance at the customer's operating base.

The variety of studies conducted by the maintenance analysis group includes inspection systems, authorized repair station operations, maintenance dispatching, shop layout, service equipment selection, and continuous study of current maintenance systems in terms of their application to Lockheed aircraft.

Aircraft Tools and Equipment

Lockheed has always designed the necessary tools and handling equipment for the service of its aircraft. The design has not been limited to the bare essentials required for line service but has extended in two ways: First, to afford the customer greater utilization of his airplane; and second, to standardize his equipment for use on other aircraft. Design of test equipment for all accessories used on Lockheed commercial and military aircraft is developed as the design of the airplan progresses, and the equipment is thus available when the first production model is delivered to the customer.

The advent of large four-engine transport aircraft has given impetus to the tool and equipment design program. Loading equipment for passengers and cargo, special test rigs, aircraft handling equipment, and special tools, are designed, insofar as possible, to insure standardization, affording the use of the equipment on all types of aircraft of the same size.

Closely allied with the airline equipment program will be the development of authorized repair station equipment for personal aircraft service and airport equipment for "ready built" airports.

Lockheed now offers a complete line of aviation equipment for aircraft from 15,000 to 100,000 lb. gross—equipment which will service any of these airplanes.

Authorized Repair Stations

As the war draws to a close, more and more aircraft are being returned for the use of private owners. It is realized that these owners have a right to expect factory service without the necessity of returning their aircraft to the factory. To accomplish this objective, competent agencies will be appointed to handle Lockheed parts and to repair company-made airplanes in accordance with methods developed at the factory.

These authorized Lockheed service stations will have personnel trained by the factory in the technique of accomplishing service and repair according to the best, most economical methods. These stations will stock a supply of approved Lockheed parts and will merchandise company tools and equipment. They will be supplied with up-to-date technical data on each model and they will be kept currently advised of new methods and materials to be used in servicing the aircraft.

The number and location of the stations will be dependent on the geographical concentration of aircraft but, in general, the stations will be within convenient flying distance of any domestic airfield.

When international aviation policy has been sufficiently defined, similar authorizations will be extended to foreign operators.

Field Operations

Lockheed will continue to maintain a staff of highly trained, competent engineers and service men in the field to assist customers. The duties of

(*Turn to page* 288)

More Seats Up... MORE COSTS DOWN

How a new upholstery shop layout, plus an improved time-motion work routine, streamlined maintenance at UAL's Cheyenne repair depot—putting seats back in the air faster.

MATERIAL REDUCTIONS in maintenance costs have often been made without purchasing new equipment. Instead, the trick has been done by rearranging and the machinery and/or changing the routing to enable work to be performed with less lost motion.

Such savings are exemplified by the careful planning in the upholstery shop at the Cheyenne repair depot of United Air Lines, where some cost savings up to 40 percent have been realized.

Confronted with both Army maintenance and reconditioning of returned aircraft, in addition to routine repairs, the plant superintendent had the choice of two courses: Either to buy more equipment, or to make that already on hand operate more efficiently. Since new machinery was not to be had, that in use was, of course, required to produce more than formerly.

Then the headaches began. Skilled workers have their own most efficient rate of turning out quality work, and attempts to speed them up involve risks in sacrifice of quality for quantity. In airline maintenance there is no such word as "second rate," so some other means had to be devised to step up output.

A careful survey showed that, in the re-upholstering of old seats and the finishing of new ones, much time was lost through wasted movement—not obvious waste of time, but a few steps here and a few there, totaling up to a large percentage of the working periods. To save these steps was a difficult problem, especially considering the layout of the shop which was then being used. So a new one was planned.

The present shop's layout and routine is shown in the accompanying diagram. It will be seen that from the time that the raw stock is classified until the finished work is gathered, the total distance traveled is only slightly more than the length of the shop itself.

Material is racked in rolls outside the stockroom and is cut off as required. The rolls are placed above one another so that any kind of material may be unrolled and cut without the necessity of moving any other roll.

Less than 4 ft. away, the cut stock is placed on the large cutting bench, to which patterns are brought a distance of 6 ft. from the pattern stockroom. Material is then cut to shape and the pattern returned to its place in the pattern storage room. The cut-out work goes to the sewing machines at the end of the building. Travel time so far, including replacing of patterns, totals only about 60 sec.

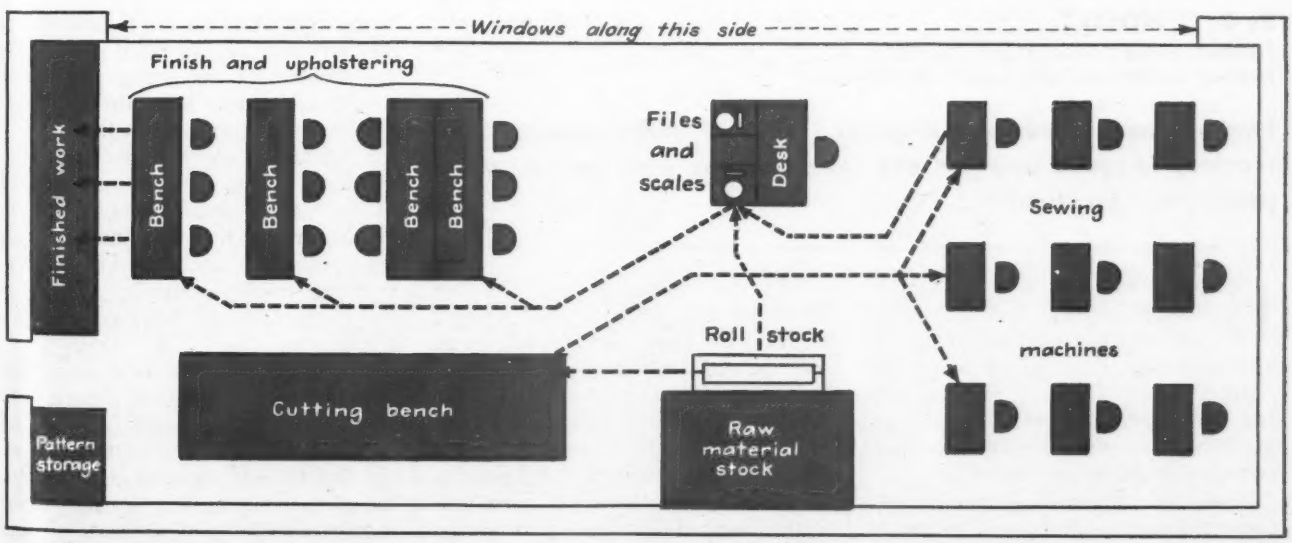
There is a battery of nine sewing machines, several being equipped for special types of work, such as binding of seams in heavy materials or doing multiple needle stitching.

From the sewing machines, the material is either taken directly to the finished-work room, after weighing, or moves to the finish and upholstery benches. During this part of the process, padding, springs, etc., are supplied from the material stockroom, over the weigh scales, in a direct path which does not interfere with movement of work in other stages of completion. Time from stock to upholstery bench—for material not going to sewing machines—is 40 sec., including weighing.

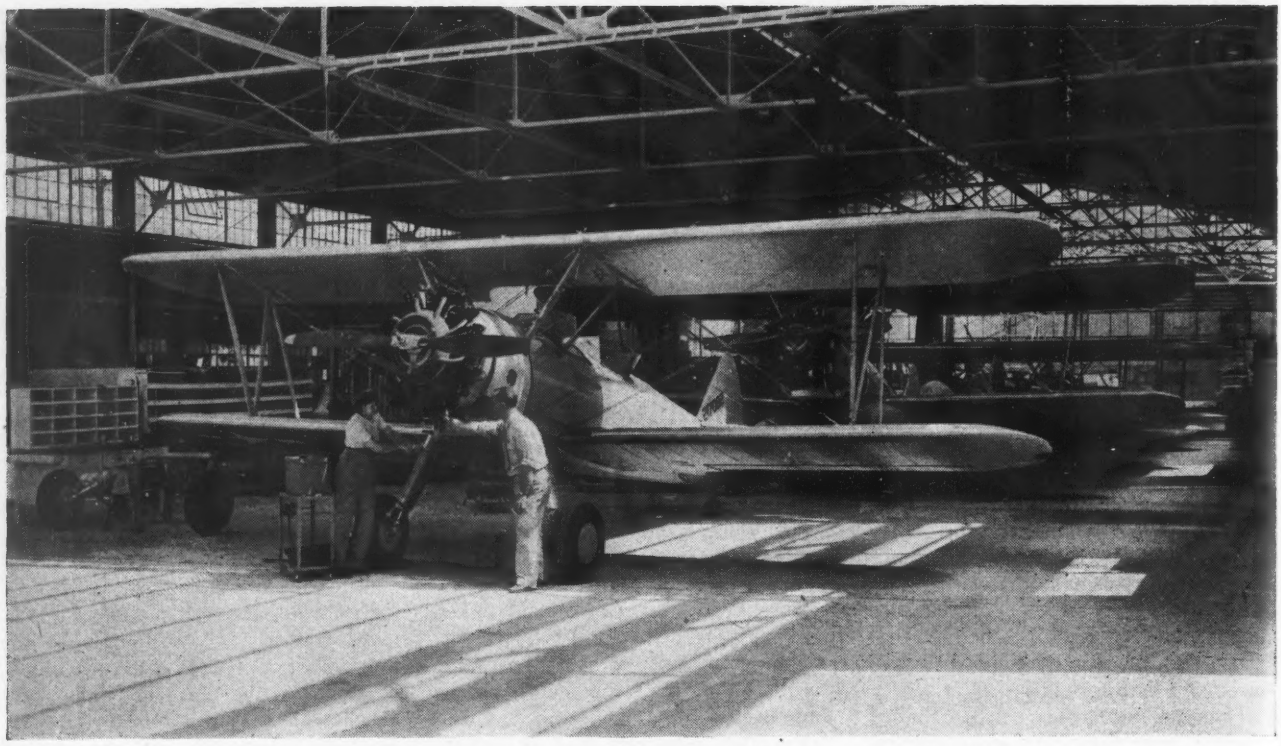
After finishing, work goes to the end of shop, and time required, including booking, is less than 1 min.

Inspection, made at cutting table, sewing machines, and finish bench, totals not over 2 min., and in the case of simple work, it frequently is only a matter of seconds. Weighing, absolutely necessary in airline work, requires merely a pause of a few seconds

(*Turn to page* 288)



Routing diagram indicates how lost motion, such as in cross travel, has been eliminated by scientific planning. Arrows show movement of material from raw storage to finished work. Patterns are kept close to cutting bench to avoid walking across busy work floor.



Production line overhaul and repair depot at Grand Central Airport—ready for postwar personal pilot's business as well as commercial work. War-developed standardization of procedures by specialists will be utilized in peacetime operations to speed service and reduce costs. (Loomis photos)

Standardized Maintenance

MEANS MORE FIXED-BASE BUSINESS

By C. C. MOSELY,
President, Grand Central Airport Co., Cal-Aero Technical Institute, and Mira Loma Flight Academy

Methods and procedures developed by AAF flight training contractors to speed overhaul and repair can be used for successful peacetime operations.

BACK IN THE EARLY DAYS of automobiles, owners found that repair and overhaul meant an individually negotiated job on which the results were, at best, problematical. No two garages were alike, no two methods were similar, no two price estimates could be reconciled.

Then came a period of standardization—and as a result today's car owner knows what will be done and how much it will cost.

Fixed base operation will, as a result of the war, offer the same class of service and repair which helped so much to make motoring a part of the American way of life.

We hasten to say that no criticism of previous aviation methods is implied; the improvements developed are merely the natural result of mass production methods evolved, of necessity, by mass demand of the war.

At each of the three fields operated by our companies for AAF cadet training, for example, we faced each night the problem of inspecting and maintaining as many as 300 training planes. Constantly we encountered the problem of necessary periodic overhaul. Production line methods systematized to the highest possible degree had to replace the old one-plane methods where the same mechanic, for instance, repaired rudder controls, made carburetor adjustments, and fixed the electric system.

This war-borne standardization was actually evolutionary, but it came with almost revolutionary speed. With 64 contract schools throughout the nation striving to improve methods, and with the Army acting as liaison agent through which improvements by one were quickly made standard for all, practices were set up whereby planes

are serviced precisely the same in Ontario, Calif., as in Lakeland, Fla.

An outstanding example of standardization is what the Air Forces Training Command call "PLM"—Production Line Maintenance. It began experimentally in 1940 and is still being improved. Today, every operation in the servicing of an airplane is prescribed in detail and is standard for all shops throughout the country.

Basic feature of PLM is the shifting of maintenance from over-all mechanics to specialists, operating in crews. Under this system, the 100-hr. inspection, for example, can be completed in 4 hr. The crew consists of four men—two on the engine and one each on the airframe and hydraulics. All can work on the plane simultaneously. In another production line, the daily inspection is being completed by specialist crews in 15 min. per airplane. Each man operates under a detailed, prescribed plan, which is the same in Maine as it is in Texas.

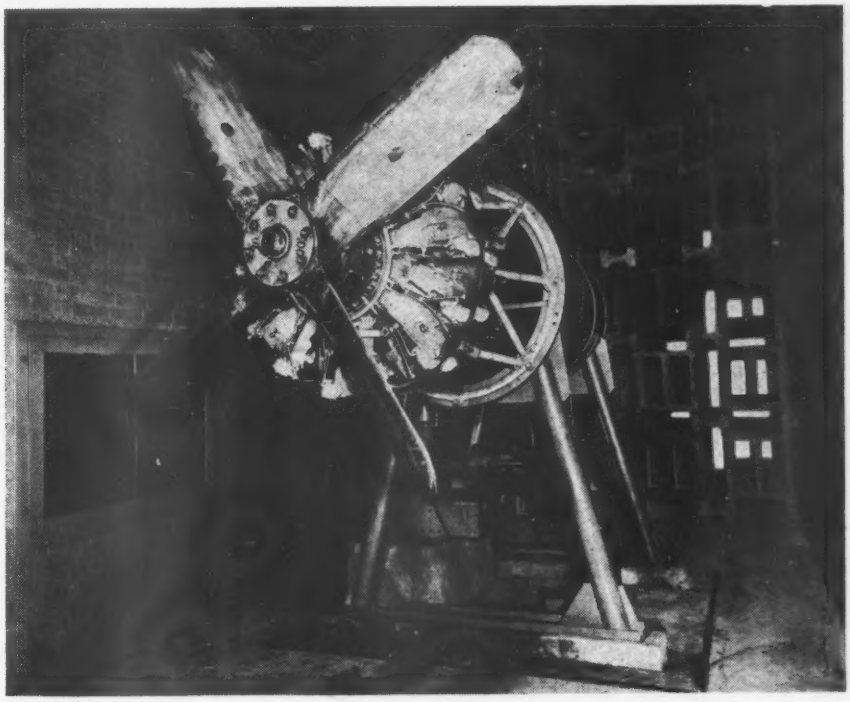
Adapted to postwar maintenance, this means that not only will these standardized methods materially speed all features of overhaul, but they will also reduce costs and improve results. It will mean that the personal flyer can leave his plane at any of the approved shops with full confidence that the work will be done according to CAA standards, with proper equipment, and according to manufacturer's specifications. And, just as important, there will be no out-of-line charges.

Although it is not yet possible to establish standardized charges because many operators are still on military work, the groundwork has been laid. The war has brought the major operators together in a common cause as never before—as is shown by membership of the Aeronautical Training Society, which is composed of the 64 schools contracted for AAF primary training. It is logical to suppose that similar cooperation can be continued in the postwar period, with some such organization taking the lead in establishment of the standardized costs.

The approved shops of the postwar era will bear as little resemblance to the facilities of early flying days as do our modern airports to those of the hayfield era.

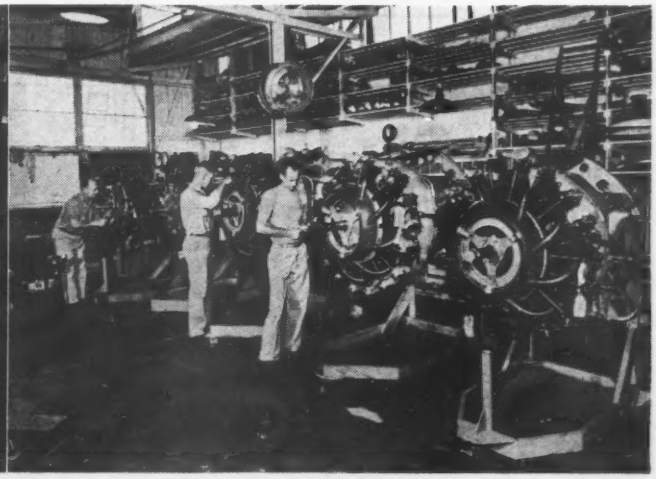
This is no halcyon dream. These shops already exist, and not as isolated exceptions. Our shops at Glendale, for instance, can handle for complete overhaul approximately 100

(*Turn to page* 284)



Among improvements being made at company's recently purchased Grand Central Airport iss $70,000 engine test unit (one cell is seen here). Although still engaged in military work, this operator is confident that expenditures such as this will, in peace, help give big league type sales and service—prime requisites of successful fixed base operation.

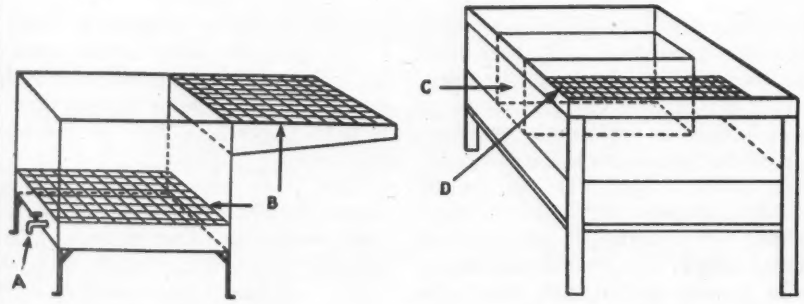
Engine teardown department (left) and production-line build-up line (right) at Grand Central have capacities for major overhaul of 150 engines per month. Shops can be quickly converted to postwar operation, while retaining capacity.



Attaining Bearing Cleanliness*

By **HUDSON T. MORTON,** *Chief Metallurgist, Hoover Ball & Bearing Co.*

Bearings—the very heart of high-efficiency mechanisms—are designed to give long wear under high loads and speeds. To insure top performance and obtain even longer life, these anti-friction units rate careful "laundering". Here's the ABC on how to do it.



Simple tanks for petroleum solvent, emulsion, or alkali solution soaking, cleaning or rinsing. Tank, left, has drain spigot (A), removable drain screens (B); tank, right, has solvent in (C) and (D) is drain rack.

FOR CLARITY OF PRESENTATION, this discussion concerning the cleaning of bearings has been divided into three parts. The first part will deal with types of contaminants and theory of cleaning to give an over-all view of problems involved. Actual cleaning solutions and solvents will then be discussed. Finally, a tentative layout for cleaning will be proposed, which can be modified for each shop to suit the quantity of bearings to be cleaned.

A special problem is involved in the cleaning of bearings because they ordinarily are received as complete assemblies with various amounts and types of contaminants to be removed. These contaminants might be grouped as:

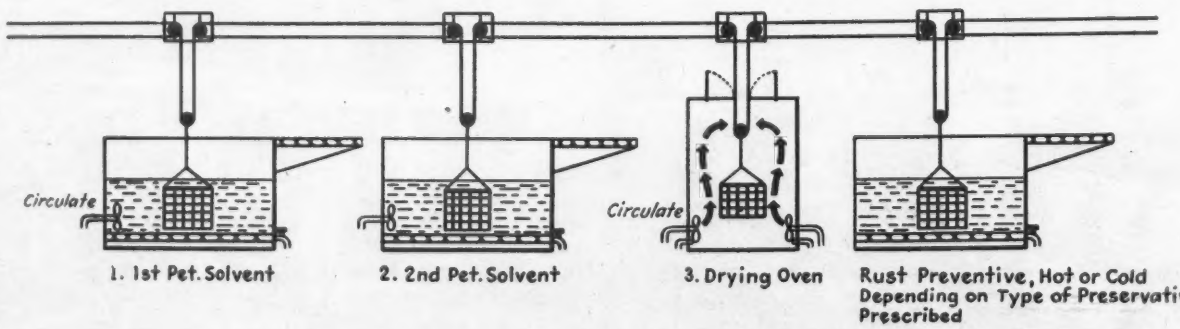
1. Dust, dirt, and sand from the atmosphere.
2. Dirty rust-preventive compound from storage areas.
3. Oxidized and dirty lubricant from service.
4. Metal chips, abrasives, etc., from machining, grinding, and lapping operations on machines where the bearings were used.
5. Residues from marking ink, etching solutions, and other numbering systems.
6. Fingerprints.
7. Corrosion.

Before cleaning operations are attempted, it is essential that a definite system be adopted for proper handling of bearings. No inspection should be attempted on a dirty bearing, and it should not be rotated. Rotation of bearings containing grit might cause permanent damage by indenting the load-carrying surfaces. No bearing should be touched with bare hands.

Cleaning Theories

The ideal method of cleaning would be to dip the bearing in a solvent to

* Based on a paper presented before the Forum of the ATSC and Anti-Friction Bearing Industry.


Circulate
Circulate
1. 1st Pet. Solvent
2. 2nd Pet. Solvent
3. Drying Oven
Rust Preventive, Hot or Cold Depending on Type of Preservative Prescribed

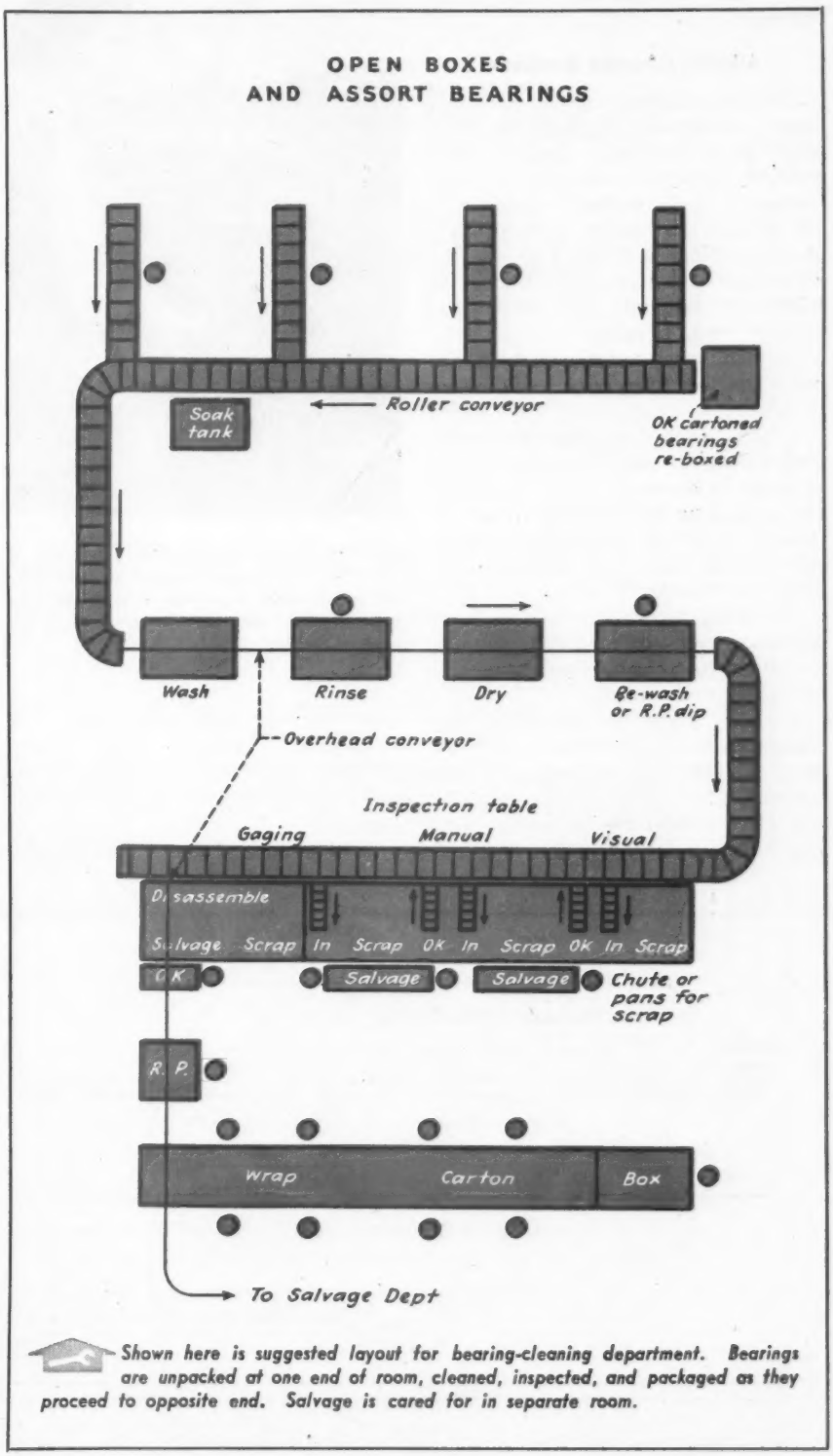
Production line layout for solvent cleaning, drying, and coating. Tanks (1) and (2) contain Stoddard solvent, or equal, and solvent in (2) must always be clean. Alternate for oven is prepared compressed air.

dissolve all contaminants, leaving the surface clean and bright. Have you ever succeeded in finding such a perfect solvent for cleaning your hands, or your clothes, or any other object? No.! Only a few oils, fats, or waxes are dissolved, and the other contaminants remain.

The most common cleaning solution consists of soap and water or alkali and water. The alkali reacts with free fats in the contaminant to give saponification (form soaps). Then, by slight mechanical action, the bubbles of the soap solution remove the contaminant to form an emulsion of water, soap, and dirt. Mixtures of solvents and water solutions of alkali or soap are called emulsions. They clean by dissolving and saponification. Thus, water solutions are more efficient cleaners then solvents alone.

Most bearings contain grease as a lubricant. Greases are mixtures of oils and various soaps. Soluble soaps (soda soap) are generally used in good ball bearing greases and are readily dissolved in hot water without addition of other chemicals. However, metal chips and other insoluble particles will remain on the bearings. Insoluble soaps are used in cup grease (lime soap), low-temperature grease (lithium soap), and water-resistant grease (aluminum soap). Hot or cold water will not dissolve these insoluble soaps. Petroleum solvents and vapor-degreasing solvents remove oils from greases but leave the soaps in the bearings. Thus, greases must be forcibly removed from bearings.

Mechanical force is probably the final answer to proper cleaning of bearings. The simplest force is a spray as used in a garden hose. The solution actually pushes the contaminant off the surface. Greater volume of spray, or higher pressure, will speed cleaning. Some surfaces may require wiping with rags, or mechanical brushing, with special fixtures for each bearing. However, wiping and brushing also add new danger of scratching bearing surfaces with dirt left on the bristles or wiping cloth from previous cleanings.



Shown here is suggested layout for bearing-cleaning department. Bearings are unpacked at one end of room, cleaned, inspected, and packaged as they proceed to opposite end. Salvage is cared for in separate room.

Demagnetization

Bearings which have been in service are subject to electrical forces established in rotation of machinery hence become magnetized.

It is necessary to demagnetize bearings after the first cleaning. Demagnetizers may be purchased or fabricated locally, or such machines as are available at various depots may be utilized. Demagnetizers should be set up in the production line of the bearing maintenance department. Foreign matter from various engine parts and other equipment breaks up during normal operation, and due to the presence of magnetic forces set up in the bearing, these particles adhere to bearing surfaces. This condition is very destructive to highly polished raceways, and it is essential, therefore, that all bearings be demagnetized.

In demagnetizing these parts it will be necessary to pass them through the machine at least once in a forward direction and once in reverse direction and, at the same time, to slightly turn the bearing assemblies in the demagnetizer. This will assure a near-perfect demagnetization.

Experience indicates that complete bearing cleaning can only be accomplished by a combination of soaking in

one solution and mechanically cleaning after the contaminant has been softened.

Alkaline Cleaning Solutions

Alkaline solutions can be used for simple immersion cleaning or two-stage spray-cleaning. Typical composition of such a solution (in percentages) is 85 sodium orthosilicate, 10 sodium carbonate (anhydrous), and, 5 sodium resinate. Another is 46 sodium carbonate (anhydrous), 32 trisodium phosphate, 16 sodium hydroxide, and, 6 rosin.

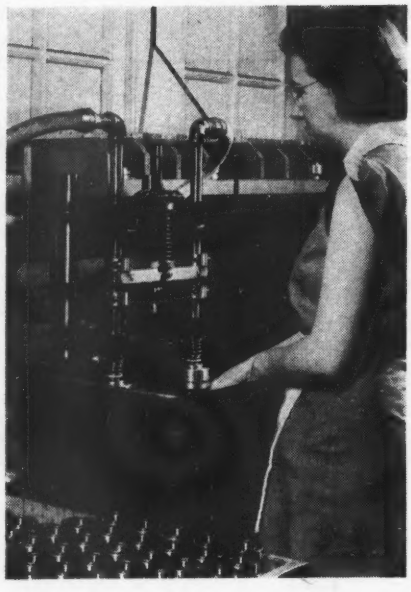
In using such solutions, there are certain factors to consider and dictates to follow:

1. This method of cleaning is intended *only* for individual pieces such as rings, balls, or retainers. It should not be used on assembled bearings because it is almost impossible to properly dry the parts (get them entirely free from moisture).

2. During processing, handle parts on hooks, racks, or in baskets suitable for satisfactory cleaner-application and for adequate drainage.

3. Clean parts by immersion and soaking in an alkaline cleaner for 1–10 min., as determined by degree of contamination.

4. Parts should not be handled with bare hands or dirty gloves during and after cleaning and preservation. A clean cloth or synthetic rubber gloves, or their equivalent, should be used; and handling should be kept to a minimum.



Special bearing-washing machine in which solvent is forced through bearing to mechanically remove foreign particles between balls and retainer or from other parts of bearing.

5. Maximum cleaner-efficiency will be obtained with solutions maintained within limits of 5–10 oz. of cleaner per gal. of water. Somewhat lower concentrations may be used if contamination is very light.

6. Concentration checks should be made at least daily.

7. The temperature range for good cleaning is 205–210 deg. F.

8. When sludge or oil and grease content becomes sufficiently high to cause unsatisfactory cleaning, replace the cleaner.

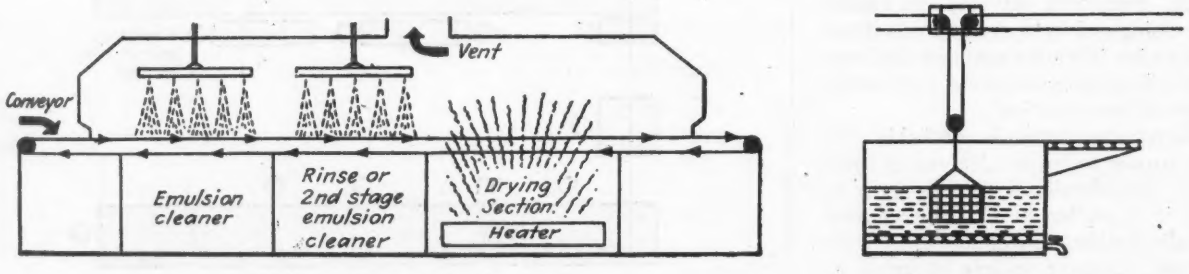
9. Water rinses which follow alkaline-immersion cleaning and just precede drying, should be kept at a temperature above 180 deg. F., and preferably near boiling. Temperatures much below 180 deg. F. can cause corrosion of parts upon drying.

10. The hot rinse water should be constantly overflowing at the surface to clear it of contaminating scum and high cleaner content.

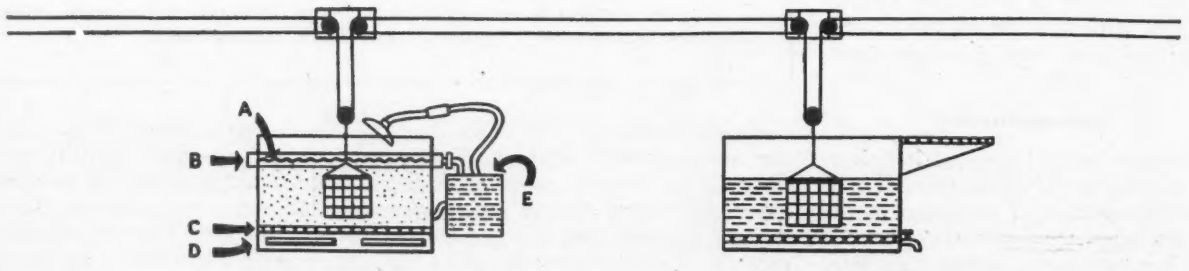
11. The required rate of overflow will vary with quantity of work rinsed, and it should be so adjusted that the water is kept alkaline, yet does not contain enough cleaner to leave objectionable amounts of residue on parts upon drying.

12. Best alkali limits for rinse water are from .02-.05 percent, calculated as sodium hydroxide. In no case should

(*Turn to page* 289)



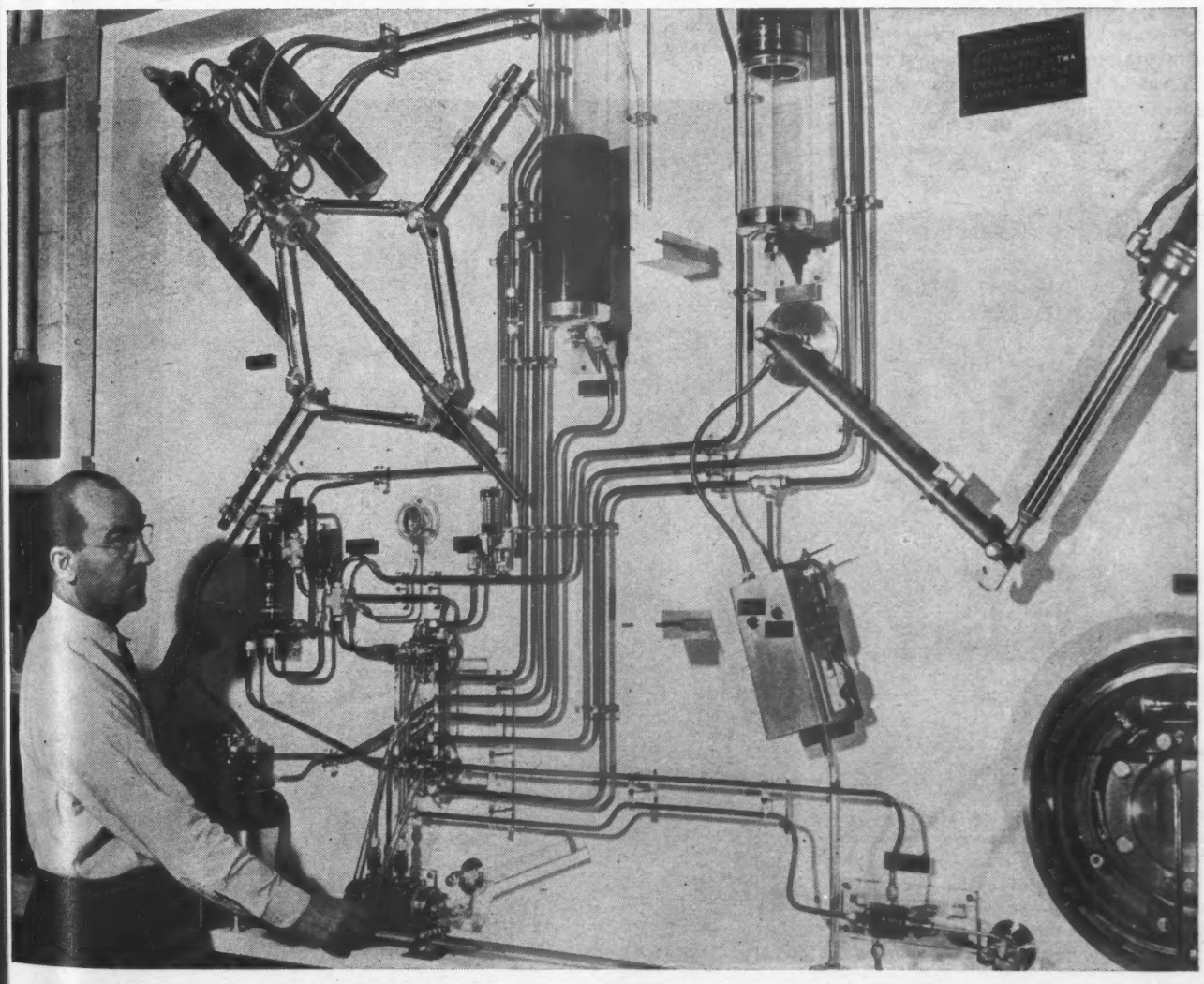
Belt conveyor washing and drying system. Blow-off with compressed air is between rinse and heat drying.



Vapor-degreasing equipment. (A) indicates drain trough, (B) cooling jacket, (C) wire screen, (D) heating units, and (E) pump tank with filters or screen.

TWA GETS DOUBLE BENEFITS FROM *Shop-Built Mockups*

Originally designed to enlighten visitors and thus save workers' time, these revealing cutaways have proved invaluable as training aids and as morale boosters.



Benjamin I. Kelly, foreman of accessory overhaul department, demonstrates remote control action of schematic display which reveals flow of fluid throughout hydraulic system. Built largely of transparent plastics, working model shows flow from reservoir through accumulator and four-way valves to landing gear and flaps and back through release valves. Action of release valves, landing gear lock, unloading valves, electric and hand pumps, and cylinders is disclosed in detail through transparent plastic covers.

DOUBLE UTILITY has been achieved with a series of unusual cutaway demonstration units built by every department in Transcontinental & Western Air's Kansas City maintenance base.

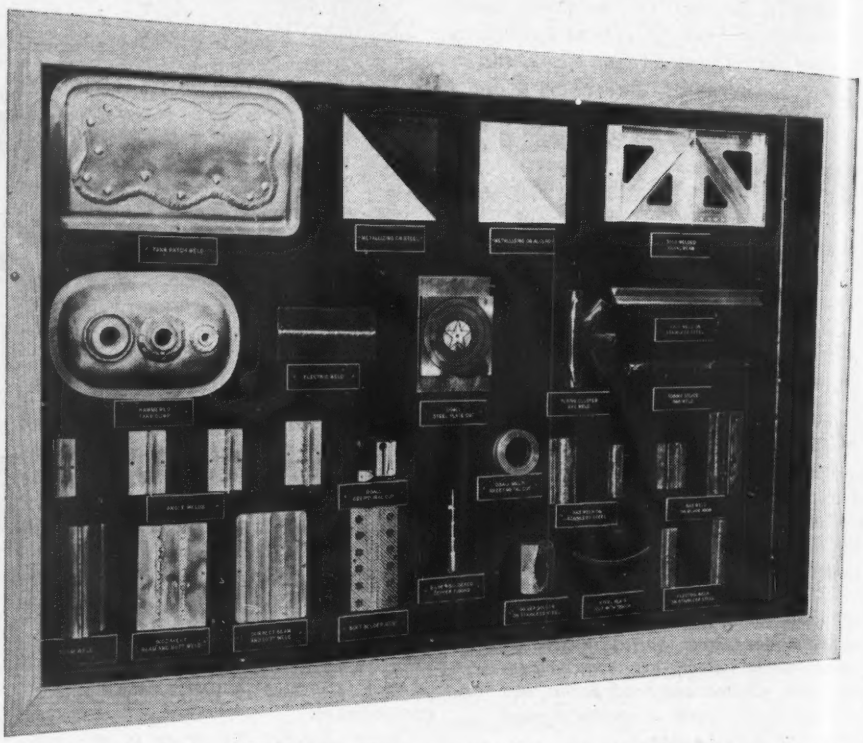
Basic idea for the series of exhibits came from John Collings, vice-president for operations, who proposed that each department create and have on display a comprehensive exhibit representative of its work. Their purpose was to save time, yet still present a complete picture to TWA visitors

without need of their going to each workbench in the department—with consequent interruptions to the flow of work.

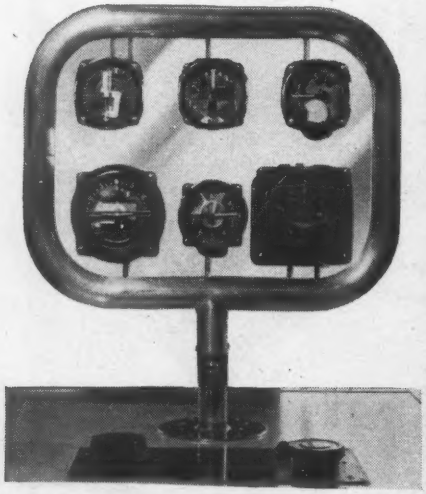
As plans developed it was decided that such cutaway models would also prove invaluable as training aids, not only to apprentice and service mechanics, but also to other personnel throughout the company. With this purpose as a goal, maintenance staff assistant W. P. Dahnke was assigned to the project and supervised its execution.

TWA craftsmen are particularly proud that no outside work was done; the exhibits represent the ingenuity and work of each department. "Since working on the exhibits, the men have shown much more pride in their departments and each claims to have the most representative display," Dahnke reports. "We feel that this rise in departmental morale has already more than paid for the project."

Many of the exhibits were created from scrap materials, and furthermore considerable experience was gained in the use of plastics. Where it was desired to show fluid flows or to reveal, yet protect, delicate working parts, metal craftsmen made their first major attempt at plastic fabrication. Maintenance officials believe this will prove useful in the future.



Mechanics in TWA's miscellaneous overhaul department built display presenting every type of metalcraft done there. Exhibit contains examples of correct and incorrect tubing, pattern marking, and riveting. This detail of exhibit shows different welding methods employed.



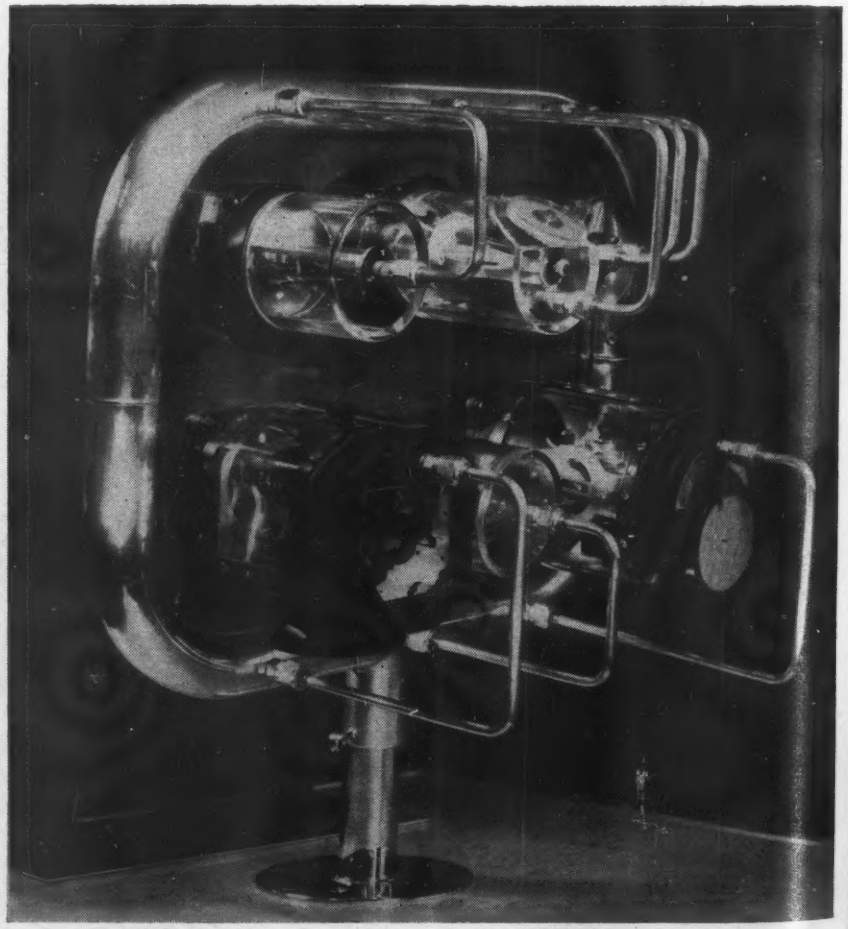
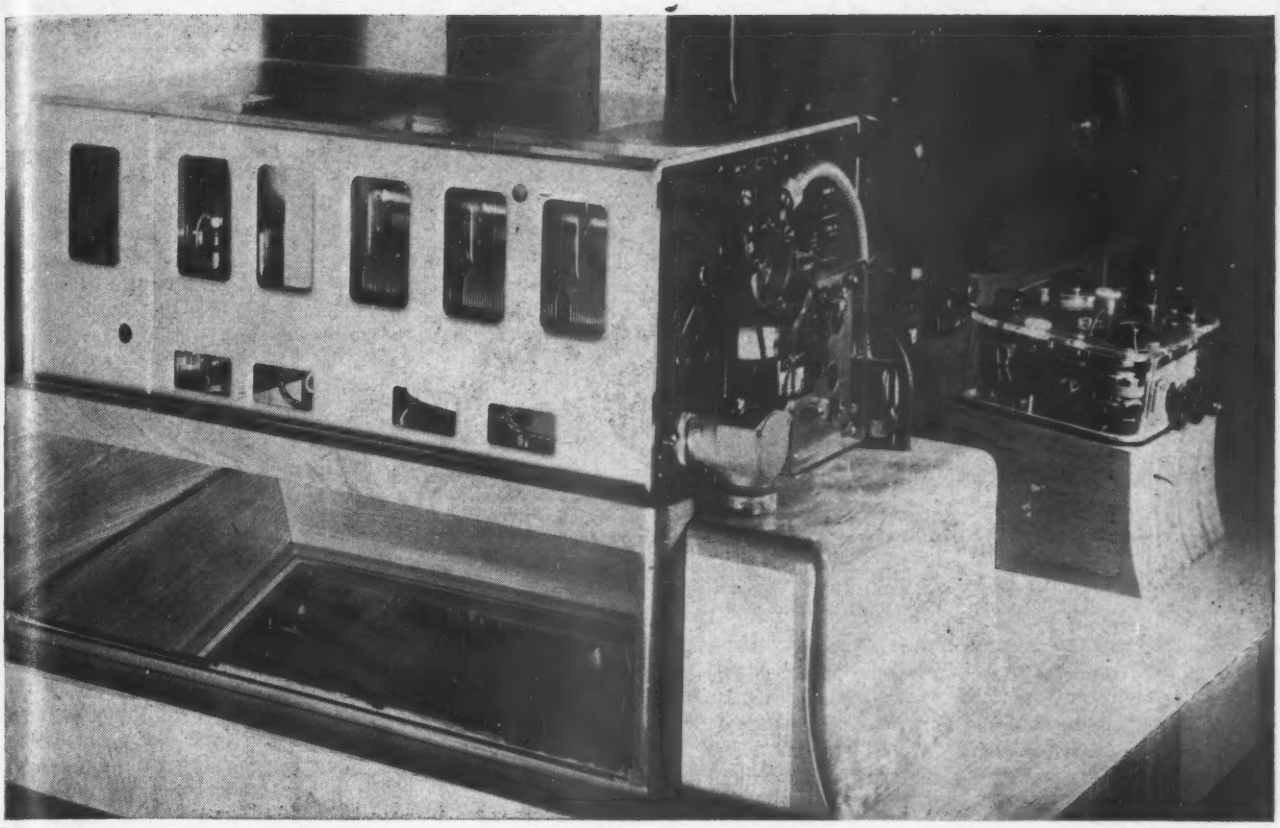
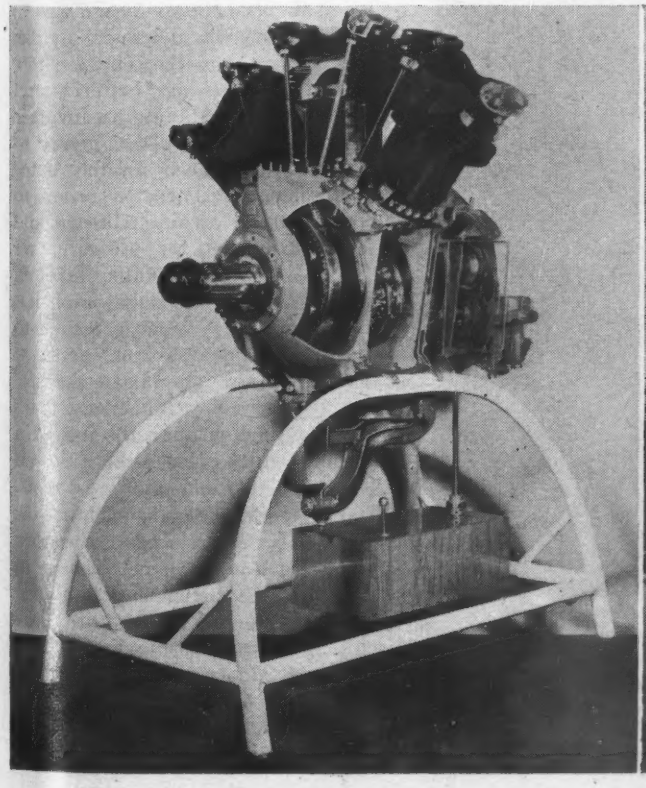


Exhibit built in TWA shops showing (above) primary flight instruments, mounted in Lucite panel supported by aluminum frame and containing pressure and suction lines to operate instruments. Panel can be offset and oscillated to simulate movement of plane about three axes. At right is rear view of panel, showing plastic covers which reveal functions of instruments while protecting delicate parts.

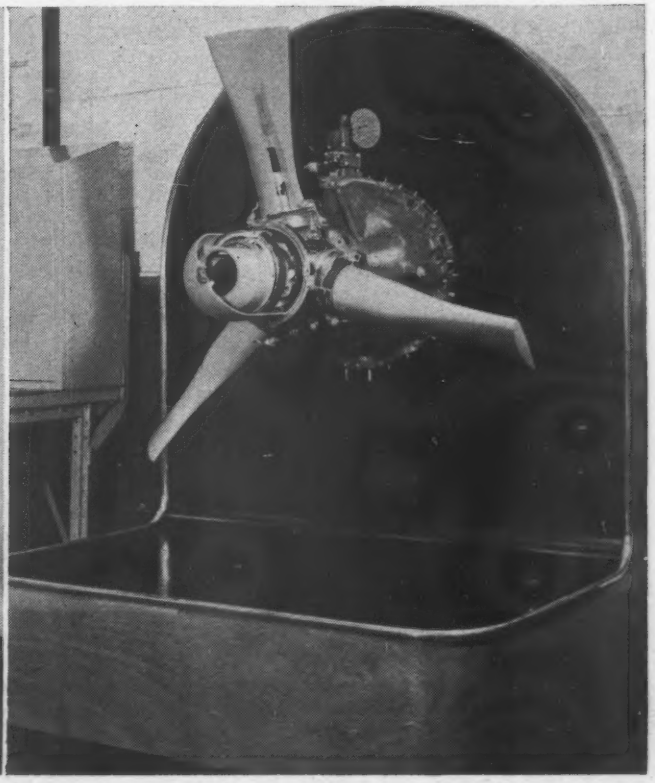


Sperry automatic direction finder is mounted above mirror by which students can look "up" to follow wiring pattern, and cases have Lucite panels to reveal all interior details. Operated by storage battery, unit works just as it would mounted in aircraft. For student work, loudspeaker and amplifier are substituted for headphones used in aircraft installation.

Cutaway section of Wright Cyclone engine is mounted on easily movable stand constructed from scrap material. Engine is driven at 13 rpm. by 1-hp. electric motor set in box on base of stand.



Working cutaway of Hamilton Standard Hydromatic full feathering propeller shows all functions, including action of slinger de-icer. Display was kept compact by removing ends of prop blades.



IF YOU CAN'T BUY IT

Make It—Better

By GEORGE WARDE, *Assistant Shop Superintendent, American Export Airlines*

American Export's budding instrument shop couldn't buy certain test equipment for love or money (the war, you know). So they made it themselves. Result: Better than they could have bought.

STARTING FROM SCRATCH less than three years ago, American Export Airlines' instrument shop today is one of the most complete in the country—able to service any instrument used on aircraft.

This growth was not the result merely of our going out and buying everything necessary; in fact, the war had already made some instruments unavailable. Now, however, the instrument department represents a triumph of whole-hearted cooperation between it and the engineering and machine departments, for together they created much of the equipment now in use.

During early operations with a distinctly new type aircraft, the only ones of their kind, many improvisations had to be made in testing and checking intruments because there simply was no precedent to go by. Many of these particular instruments had never been used in commercial aircraft before which, together with the unavailability of equipment to properly check them, complicated the instrument maintenance picture. Despite these conditions, though, the line maintained schedules with properly functioning equipment.

In setting up the new shop, we took into consideration all the instruments we had been using and all those that we felt might someday be used on the company's aircraft. This was done by listing all the currently used instruments and then trying to combine one test stand for the various units so as to standardize layout and establish a pattern for future growth of the shop.

We had also to consider the problems of space, availability of equipment, and efficiency of layout. The space angle was overcome by setting up the test equipment in a central location with regard to the individual work benches. This not only enabled personnel to test equipment near the individual bench, but it also made it possible for more than one person to check or test the same type instrument at the same time.

To further increase efficiency, the shop was divided into four sections:

1. Electrical and general instruments
2. Sperry instruments
3. Machine work and hydraulic, and
4. Stockroom

In order to keep the Sperry section free of dust and dirt which might be generated by any of the other sections, it was separated from the balance of the shop by glass partitions, as were the machine shop and hydraulic sections.

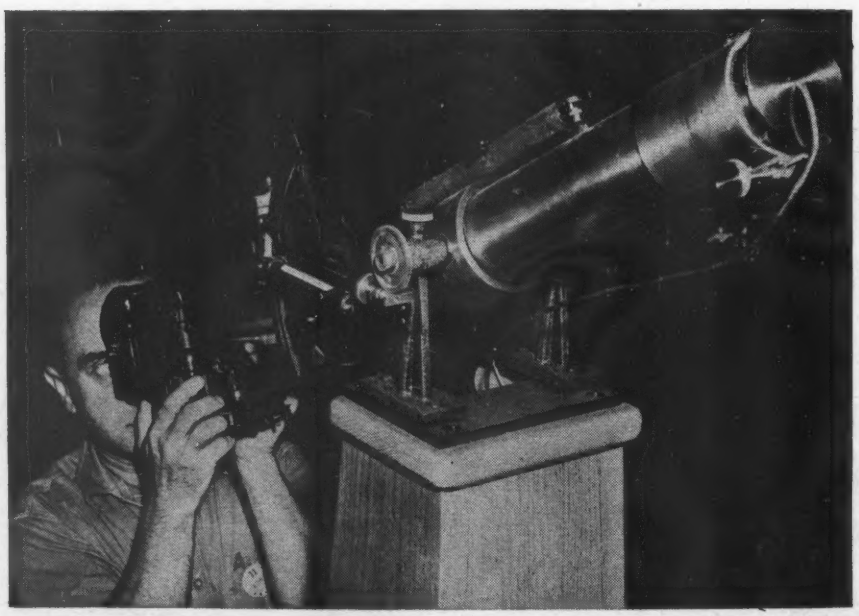
Although the availability of equipment was our biggest problem at that time, we now see that it was a fortunate circumstance because we have designed and built most of the instrument shop equipment ourselves for our specific needs and have, incidentally, made marked improvements over some of the equipment which is now on the market.

One of the first things we did was to set up a Mallory rectifier to supply d.c. current throughout the entire shop, thus eliminating storage batteries and the necessity for installing an inverter to change the available d.c. power to 26.400 cycles a.c. power for the Autosyn instruments. Then, in order to properly test the various Autosyn and Selzen instruments for pressure, we put in operation a 2,700-lb. nitrogen tank with a 0-300-lb. regulation on it.

This enabled us to get pressure to any instrument by individual pressure valves and it also eliminated the use of hydraulic fluids. Conversely, vacuum is obtained through the use of a small pump which operates both Selzen and Autosyn manifold pressure panels.

The temperature and machine instruments are also placed on benches with 60-deg. angle panels back to back. These instruments include those for testing oil temperature, carburetor air temperature, cylinder head temperature, Wheatstone bridge, decade box, and any other temperature instrument built.

The need for bell jars or high alti-



Ingenuity has played a large part in development of American Export Airlines' instrument shop. Established less than three years ago when some test equipment had been made unavailable by war, cooperation with other company departments made it possible to design and build many essentials. Here, for example, is octant collimator designed and built in AEA shop. Instrument has primary advantage of eliminating necessity for any outside sighting.

tude test chambers was acute, and being unable to purchase them due to the existing emergency, we took a 16-in. piece of sewer pipe, 22 in. long, and welded a plate on the back and a flange on the front covered with lapped plate safety glass. By providing an inlet and outlet fitting, we were able to evacuate this chamber and simulate a condition up to 50,000 ft.

We designed and built two of these units, which are operated from one vacuum pump, and which use two barometers, one for each bell jar, calibrated in 1,000-ft. increments. In addition to this equipment for testing and calibrating altimeters, rate of climb indicators, and for any other altitude tests for various instruments, we purchased a Pioneer master barometer that is automatically temperature-controlled and is checked for accuracy with three other airlines daily. This instrument is used as our master instrument for setting barometric pressure.

Accurate checking of avigation instruments was likewise difficult without a collimator. With little likelihood of obtaining an octant collimator until after the war, the heads of the engineering, instrument, and machine departments collaborated in producing a collimator which will accurately check the entire range of any type octant now in use and do it with greatly increased speed.

To build this collimator it was necessary only to purchase two spirit levels, the necessary lens, and an old sextant, for the rest of the material was made from parts available in the various shops. The tube, which is something over 20 in. long, has a built-in light with a shield over it, having an aperture 0.0135 in. This is the star "fix" and faces inward along the tube toward the lens, whose focal length is 20 in.

The light box is so arranged that exactness of focus may be obtained by use of a rack gear and pinion upon which it is mounted. Since the tube is mounted on bearings, between two standards, it may be swiveled to any angle from 0 to 50 deg. and it utilizes a worm gear integral with the swivel so that fine adjustments can be made. The tube has a sensitive spirit level attached to the top to determine its horizontal position. Mounted on the side of the tube, by means of an adapter plate, the quadrant of the sextant with its sliding indice and vernier adjustment can be set at any desired angle. Mounted on the indice is a second spirit level.

When the desired angle is obtained on the sextant, the angle of the tube is changed until the spirit level of the sextant indicates the horizontals. The consequent reading shows the angle of the tube, and by sighting the star in the tube, the reading of the octant may be checked against the reading of the collimator sextant. A primary advantage of this instrument is its location in the instrument shop, thus eliminating the need for sighting an outside point, where adverse weather conditions might preclude the possibility of octant adjustments.

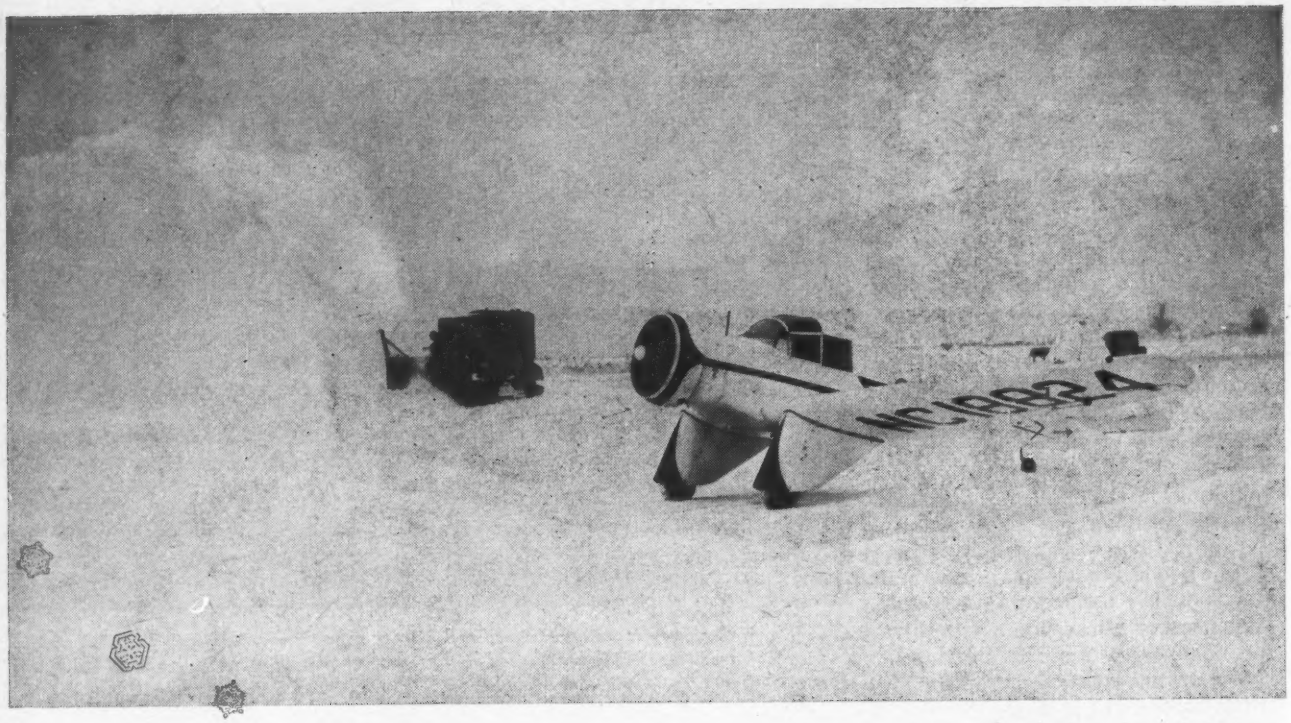
For some time we have been dissatisfied with both the accuracy and tolerance of the standard methods for checking tachometers, so we employed an electric timer and revolution counter and made our own chrono-tachometer. The time formerly consumed in this operation has been cut in half, and a far greater degree of accuracy has been attained in that tachometers can now be checked to a tolerance of plus or minus 1 rpm. This procedure is to our knowledge the first time a chrono-tachometer has been used to replace a stroboscope in checking tachometers.

In checking out automatic pilots it had been necessary to put the unit in the aircraft and calibrate it with the engines running, then take it back to the shop for any necessary adjustment, and then again out to the plane and start the engine and check it all over again. This procedure was necessary since it had been impossible to purchase the necessary equipment, so we designed and constructed the entire unit in the shop. It is today one of the most complete units at La Guardia Field.

In this connection we had quite a headache with servo units, because it was necessary to run them in for 6 hr. after overhaul. Besides the loss of time, this was inconvenient because it was necessary to use the same machine that was used to check out automatic pilots. This definitely put us at a disadvantage, so we designed and built a unit which automatically runs in two servo units for any length of time we desire. To the best of our knowledge this is the only unit of its kind in the country.

Chrono-tachometer, designed and built in Export's own instrument shop, with which tachometers can be checked to tolerance of plus or minus 1 rpm. and which cuts former testing time in half.

AEA adaptation of manometer which saves 20 percent time in checking and calibrating airspeed indicators. Fixed mounting and combined regulator and bleed assembly make it possible to simultaneously calibrate three indicators used by pilot, co-pilot, and avigator. Here, Foreman John Bowley shows how it's done.



Snow removal equipment, as shown here, is essential in assuring winter operations at northern airports.

IT'S WHAT YOU DO *Before* IT SNOWS

Half the work of snow removal is done prior to the storm. For the machinery used to keep the airport clear of drifts must be inspected and made ready for the day when the plows go out—so that the planes can come in.

WHEN SNOW STARTS TO FALL, it's too late to start readying the machinery with which to keep the airport traffic going.

Breakdowns and delays from neglected snow-removal equipment may result in heavy, hampering drifts, for the snow won't wait until you're ready. It "falls when it falls," regardless of consequences to the airport.

In these days, when repairs are difficult to obtain and slow transportation of new parts almost guarantees that broken-down vehicles will remain that way a long time, it is doubly important that nothing in the way of preparation for bad weather be left to chance.

There are but few points on present-day motor vehicles which require special preparation for the heavy work of snow removal. But these points in question bear the tremendous stresses involved, and hence they must be carefully checked for wear and adjusted so that they may give continuous service during the emergency. Double tires must be changed for single ones; clutches and brakes have to be carefully adjusted; and gears and differentials require more exact adjustment than would ordinarily be considered necessary.

Reason for this lies in the fact that snow removal is a job in which there is no standard by which to measure the stresses imposed on the machinery. Not only is there the normal truck load—for lots of ballast is required to give wheel traction—but there is also a twisting, sidewise thrust on the entire structure, caused by plowing the snow and forcing it into dense windrows at the side of the truck's path.

Engine maintenance is understood possibly better by aircraft mechanics than by most others, so it will be assumed that the engine is in typical airplane engine condition; that is, practically as good as new.

First of all, it will be necessary to remove the usual double rear tires and replace with single ones (Fig. 1a and 1b). Reason for this is that snow gets under the wide double tire, lifting the outer one off its firm footing and causing it to slip. Another reason is that the rear wheels—when double tired—have more traction than the front, tending to make the front wheels jump and slip, thus throwing heavy additional stresses on both wheels and axles.

Changing to single tires is not a difficult operation, but stud breakage will result if instructions are not followed. The wedge ring is removed by taking off the six holding nuts. Then the outer tire and rim are taken off, followed by the flat spacer ring and the inside tire and rim. This completes removal of dual tires.

The wedge ring is then replaced, with offset slanting inwards over the wheel and valve opening in correct position. The tire is then placed on the wheel, with drop wedge side of rim outward, and is clamped in place with six rim lugs and nuts. These lugs are only used with single tires. A rim wrench is the only tool which is needed here.

Chains should be used on all wheels, preferably the type with two link spacing. Operating a snowplow without chains results in overstressing the differentials, due to slippage.

Clutch pedal adjustment is necessary to allow full clutch engagement. Clutch ring (shown in Fig. 2) should be adjusted to give correct clearances (see Fig. 3). This adjustment is made by moving the ring with a heavy screwdriver engaged with the teeth in the ring face. Distance (A) is necessary to allow for normal clutch wear, which would eventually bring the clutch pedal arm against the floorboards. When the clutch has been correctly adjusted, it should be fully disengaged when distance (B) between bottom of pedal and floor is ¾ in. If these adjustments cannot be made as directed, new clutch facings are necessary.

Transmission and transfer gear case should be inspected for cracks or leaks which, if present, should be welded. Leaking gaskets or oil seals should be replaced. Transfer chain should be adjusted until it has not more than ½ in. slack motion. This is done by turning eccentric housings (Fig. 4) until indicators on both ends are at the same index points. If this point is not carefully observed, the shaft will be out of line and the result will be damage to both shaft bearings and chain.

Examination of Fig. 5 will give a clear understanding why a center differential is required when drive is to all four wheels. As each wheel turns on a different radius, while delivering its share of power, and as the front axle averages a higher speed than does the rear, it is obvious that some method is necessary to provide differential action between the two axles, in addition to the conventional differential in the axles themselves. This is the reason for the transfer and center differential, and it is essential that the mechanic understand this point. The differential should be adjusted by turning the notched collar with a screwdriver (as shown in Fig. 6). A gasket should be used under the inspection plate when the latter is replaced.

In connection with the above, the action of the center differential lock should be checked, because stretching of the control cable from the cab will result in improper operation of this lock. In this case, the lock cable should be corrected until the lock works satisfactorily.

Fig. 2. Clutch assembled in flywheel, with housing removed to show method of making adjustments with screwdriver. In practice, housing would be in place, and access to clutch would be by inspection plate.

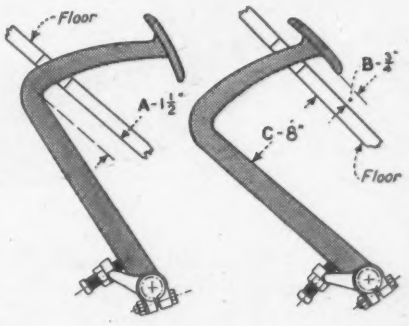
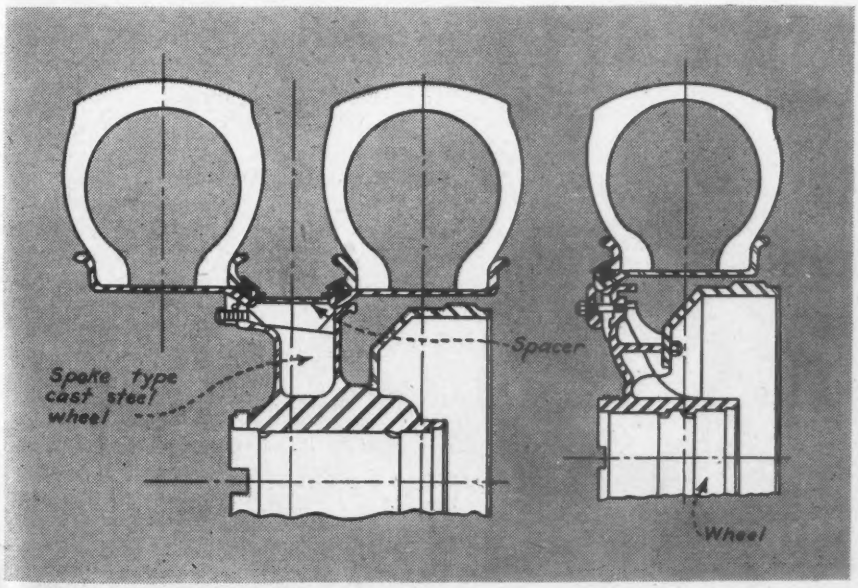


Fig. 3. Pedal clearance is important, because insufficient motion may prevent correct clutch action. If dimensions shown cannot be obtained by adjusting clutch (as shown in Fig. 2), then clutch requires refacing.

Fig. 1. Method of attaching single rear tires for snow removal. Notice that center line of single tire lies midway between those of dual wheel.



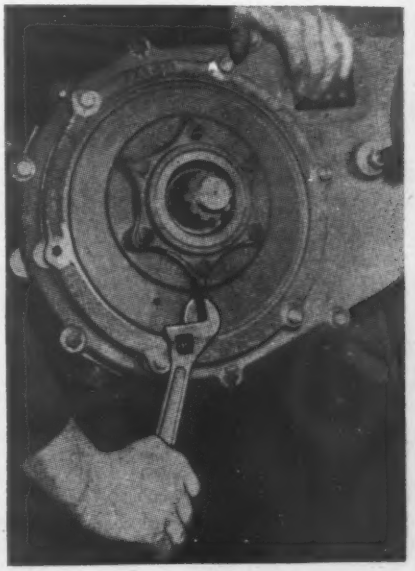


Fig. 4. When adjusting transfer gear chain, indicators at each end of casing must be in same position, otherwise shaft will not be in alignment.

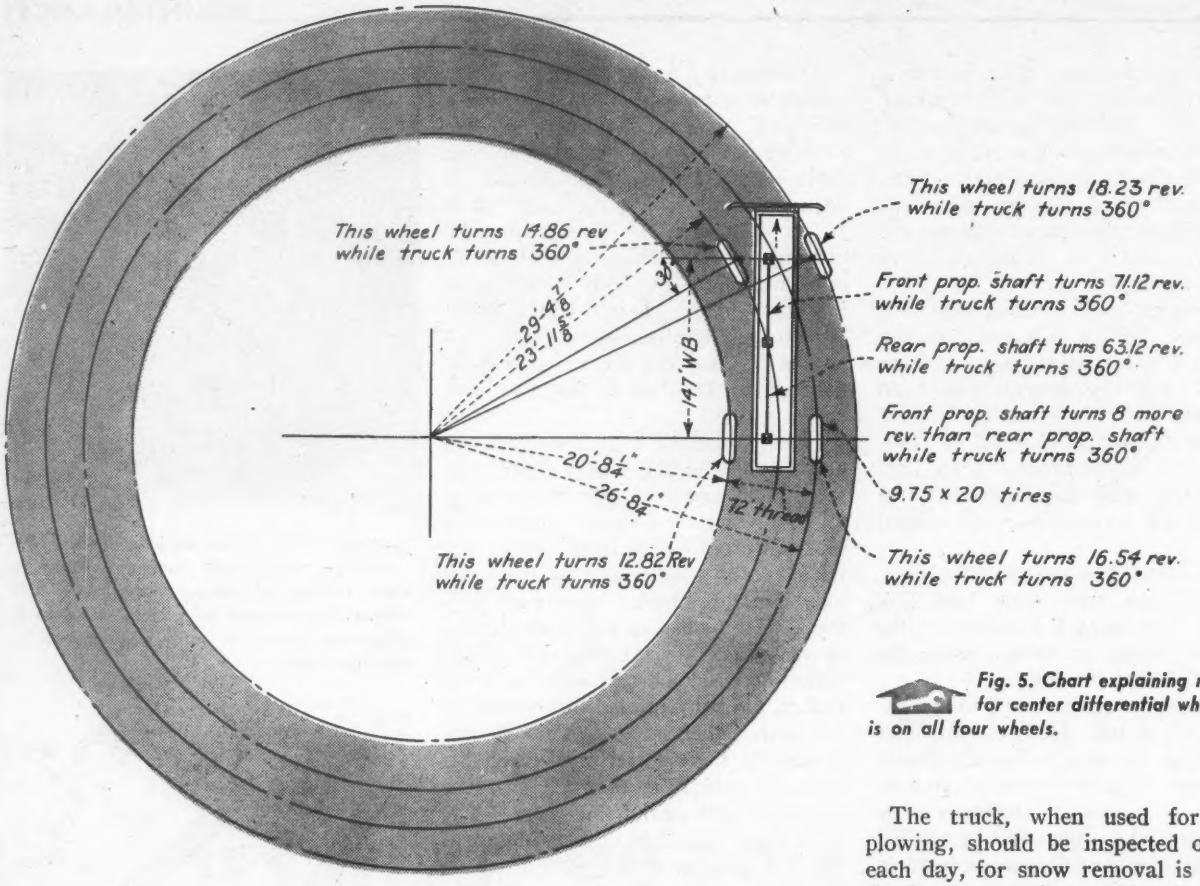

This wheel turns 18.23 rev. while truck turns 360°
This wheel turns 14.86 rev. while truck turns 360°
Front prop. shaft turns 71.12 rev. while truck turns 360°
Rear prop. shaft turns 63.12 rev. while truck turns 360°
Front prop. shaft turns 8 more rev. than rear prop. shaft while truck turns 360°
9.75 x 20 tires
This wheel turns 12.82 Rev while truck turns 360°
This wheel turns 16.54 rev. while truck turns 360°
147" WB
72" thread

Fig. 5. Chart explaining necessity for center differential when drive is on all four wheels.

SAE No. 90 mineral oil is used in the transmission, transfer, propeller shaft, steering gear, and axle differential housings. Wheel bearings of both axles should be given new grease every 8,000 mi.

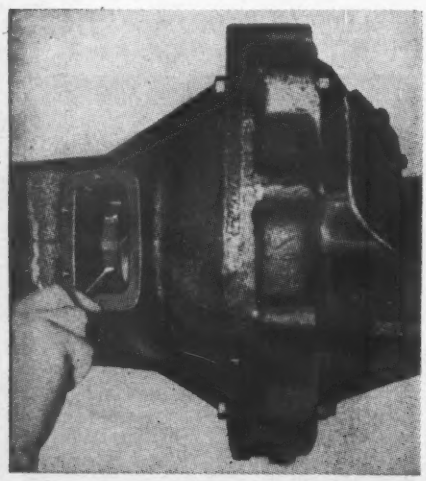
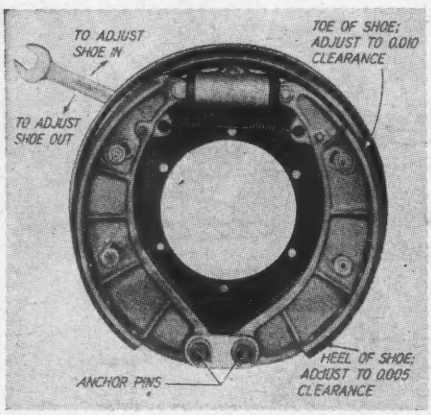


Fig. 6. Method of adjusting differential by using screwdriver on notched collar (A). Gaskets should be inspected and replaced if they show signs of leakage.

Fig. 7. Brakeshoe clearance should be carefully checked to see that it conforms to figures given here.

Front and rear axles require no special preparation for winter use, but it is advisable to check pinion and ring gear adjustment, wheel bearings, and front axle ball and socket adjustment, while inspecting the axles.

Brakes should require little attention beyond adjusting to the clearances shown in Fig. 7. Some operators advise giving front brakes slightly more clearance than the rear units, claiming that this permits the front—steering—wheels to turn more easily when brakes are applied on a curve. However, this is a matter for each driver to decide for himself, since equal adjustment of all brakes also has been found to be satisfactory.


TO ADJUST SHOE IN
TOE OF SHOE; ADJUST TO 0.010 CLEARANCE
TO ADJUST SHOE OUT
ANCHOR PINS
HEEL OF SHOE; ADJUST TO 0.005 CLEARANCE

The truck, when used for snow plowing, should be inspected over-all each day, for snow removal is among the hardest work to which it can be subjected. Wheel stud nuts, especially, have a tendency to loosen up. Owing to the engine being run for considerable periods in proportion to mileage, careful records of working hours should be kept so that engine oil can be changed and the crankcase and lubrication system flushed out every 60 working hours. Recording of mileage alone is of little use when operating almost continuously in low gear.

When attaching the snowplow, it should be remembered that this piece of equipment is quite heavy; further, due to the nature of the work performed, it exerts a heavy stress on the framework of the truck. For both these reasons the snowplow should be coupled as closely as possible to the vehicle.

In mounting, place plow and truck on a level floor. Do not attempt to attach the plow when the truck is on an uneven footing, because it will be almost impossible to align the two pieces of equipment so that they will give satisfactory service.

After the plow is ready for operation, the truck should be ballasted, either with material which will not shift—such as sand bags—or material which is fastened down to prevent movement. Weight should be so distributed that total loading, including weight of plow, should be evenly divided over all four wheels.

Service Snafu

NIPPED IN THE BUD*

Douglas develops fast-moving publication with worldwide distribution—to get maintenance information where it's needed while problems are still in embryo stage. Result has been more combat and transport planes in the air more of the time.

AN AIRPLANE CAN BE LOST from combat or transport duty merely because a valve has been improperly re-assembled in the field. It might be a perfectly natural mistake, but with thousands of planes of this same model in service in almost as many parts of the world, the potential danger is increased that many times.

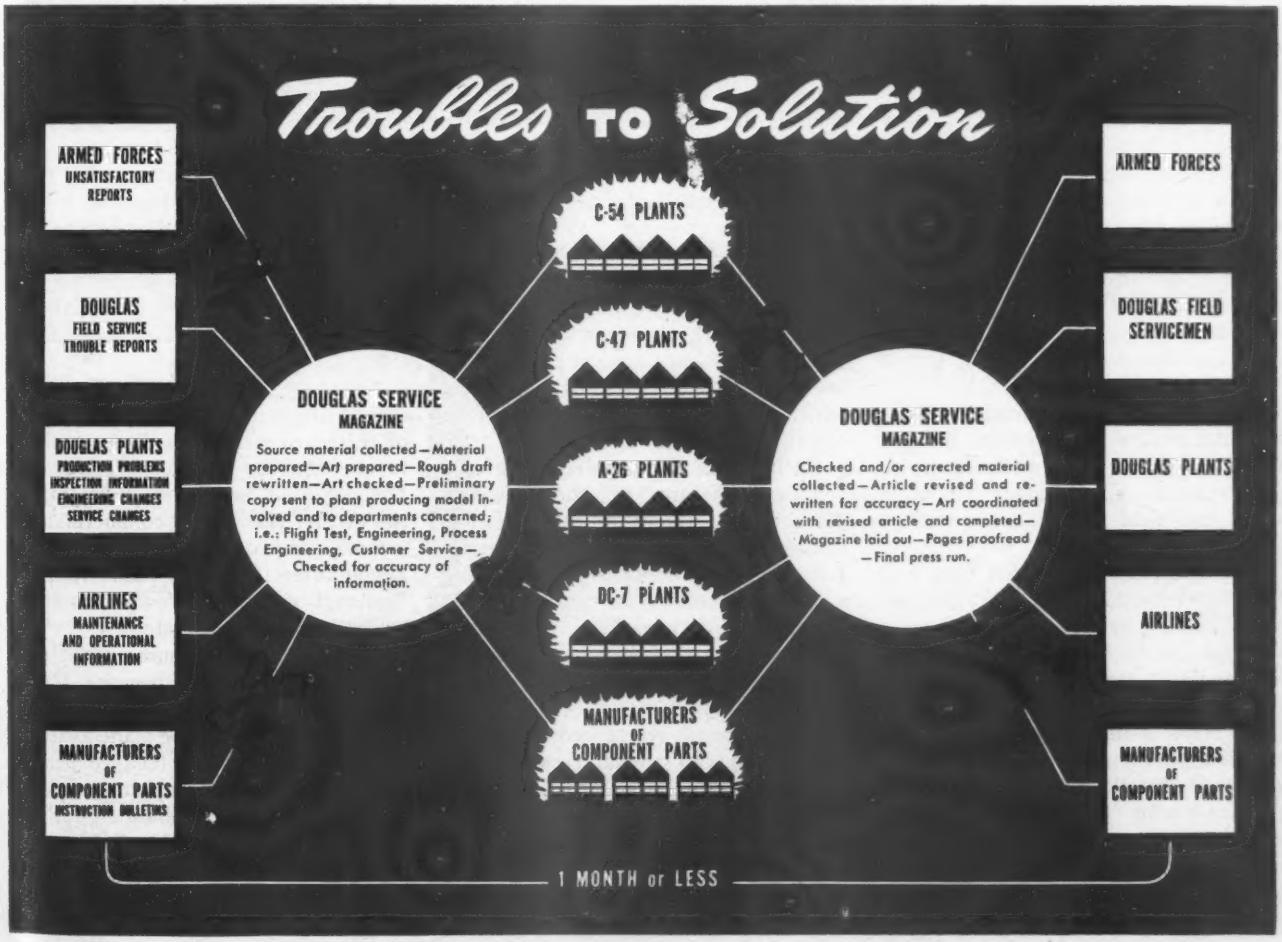
It is a danger which makes absolutely imperative the rapid and complete distribution of instructions for the correct assembly procedure. Early last year Douglas Aircraft Co. realized that current service questions could no longer be handled entirely by individual correspondence and field service representatives, and so it sought new means of achieving faster information distribution.

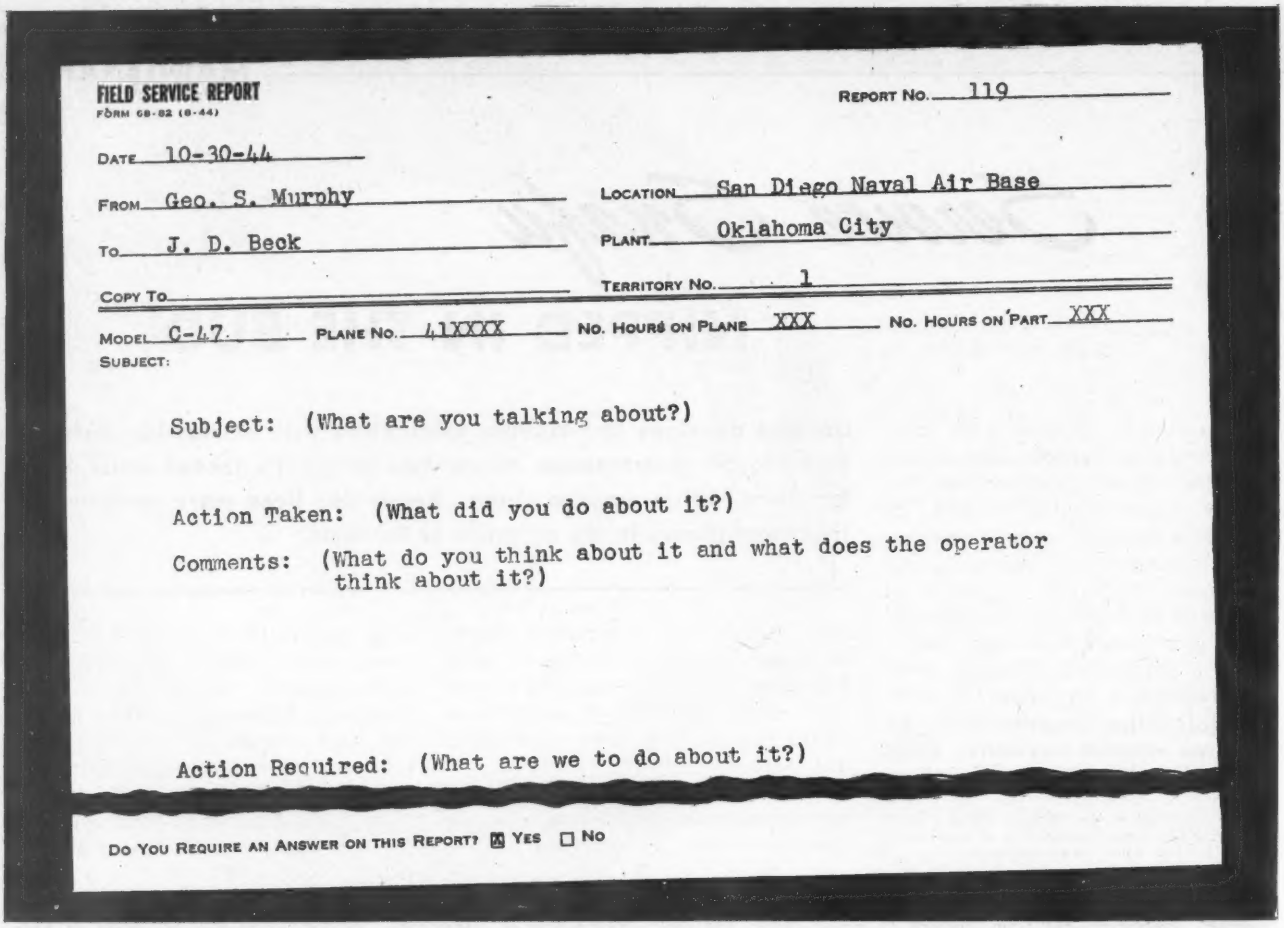
Creation of a new type of service and maintenance publication, *Douglas Service*, solved the problems arising from the greatly increased use of aircraft, rapid technical advances, constant changes, development of new Douglas models to meet war needs, and the large numbers of newly trained military and commercial maintenance personnel.

In April of last year, 1,000 copies of the first issue went to military officers,

* Like all work of the Douglas Service staff, this article has been prepared as a cooperative venture by the whole organization.

Here is how information about troubles—often only potential—get from Douglas to armed forces and airlines in a month or less. Great volume of Douglas craft in service in all parts of the world made necessary this new means of speeding distribution of information essential to greater utilization of both combat and transport planes.


Troubles TO Solution
ARMED FORCES
UNSATISFACTORY REPORTS
DOUGLAS
FIELD SERVICE TROUBLE REPORTS
DOUGLAS PLANTS
PRODUCTION PROBLEMS
INSPECTION INFORMATION
ENGINEERING CHANGES
SERVICE CHANGES
AIRLINES
MAINTENANCE AND OPERATIONAL INFORMATION
MANUFACTURERS OF COMPONENT PARTS
INSTRUCTION BULLETINS
DOUGLAS SERVICE MAGAZINE
Source material collected—Material prepared—Art prepared—Rough draft rewritten—Art checked—Preliminary copy sent to plant producing model involved and to departments concerned; i.e.: Flight Test, Engineering, Process Engineering, Customer Service—. Checked for accuracy of information.
C-54 PLANTS
C-47 PLANTS
A-26 PLANTS
DC-7 PLANTS
MANUFACTURERS OF COMPONENT PARTS
DOUGLAS SERVICE MAGAZINE
Checked and/or corrected material collected—Article revised and rewritten for accuracy—Art coordinated with revised article and completed—Magazine laid out—Pages proofread—Final press run.
ARMED FORCES
DOUGLAS FIELD SERVICEMEN
DOUGLAS PLANTS
AIRLINES
MANUFACTURERS OF COMPONENT PARTS
1 MONTH or LESS



FIELD SERVICE REPORT
FORM 68-82 (8-44)

REPORT NO. 119

DATE 10-30-44

FROM Geo. S. Murphy

LOCATION San Diego Naval Air Base

TO J. D. Beck

PLANT Oklahoma City

COPY TO

TERRITORY NO. 1

MODEL C-47 PLANE NO. 41XXXX NO. HOURS ON PLANE XXX NO. HOURS ON PART XXX

SUBJECT:

Subject: (What are you talking about?)

Action Taken: (What did you do about it?)

Comments: (What do you think about it and what does the operator think about it?)

Action Required: (What are we to do about it?)

DO YOU REQUIRE AN ANSWER ON THIS REPORT? ☒ YES ☐ NO

Douglas Field Service Report form, with questions in parenthesis indicating material which would be written under each heading. These reports very often provide material for accounts going into Douglas' unique publication on maintenance.

airline executives, and manufacturers of component parts. Today, over 10,000 copies go all over the world each month. A large percentage goes directly to the men who actually service the planes—and these men keep writing in for more. It has been conclusively demonstrated that this monthly publication can often keep troubles from becoming chronic by anticipating them and by speedily circulating correct maintenance procedures to all operators.

It is felt that the production of this publication lifts a tremendous burden from the already overworked service departments, since many answers reach the field before the questions themselves are asked.

The magazine is divided into sections corresponding to the Douglas models in current use. Within these sections are developed proper lubrication methods, trouble shooting procedures for all systems, concise and complete service instructions, new maintenance shortcuts, advance information on new installations, and practical field re-works. Articles are illustrated by photographs, cutaways, schematic diagrams, and charts to clarify beyond doubt the particular service problem or procedure.

It has been found that diagrams of complicated systems or assemblies, such as the automatic pilot, hydraulic regulators, accumulators, etc., are of invaluable assistance in showing the engineer or mechanic just what takes place inside the unit. This not only eliminates improper disassembly and assembly but localizes the trouble and prevents much unnecessary investigation and labor. Cartoons are also used frequently to warn against carelessness in operating and handling equipment which may greatly reduce the life of the airplane parts.

Each article is organized to give a complete picture of the problem. Troubles are traced to their possible causes and the remedies are given in full detail. Procedures for checking systems, assemblies or parts, steps in installation changes, etc., are stated as clearly and simply as possible. Every care is taken to prevent wordy, ambiguous instructions.

Amply cross-referenced quarterly indexes and an annual recapitulation are also organized by model, and then by major and minor subject breakdowns.

In order to achieve thoroughly correlated and coordinated answers to service and maintenance problems, a complex but efficient system for gathering and checking material has been developed. One of the chief difficulties is getting new information into the field in the shortest possible time, yet clearing and coordinating it with the major Douglas plants, three of which are in the Middle West. Gradually, the following procedure for gathering and checking material was evolved to cover all phases of the situation.

Naturally, the ideas for all articles do not originate with the staff. Many of them are written as direct answers to questions or troubles submitted by Douglas Field Service Representatives, the Army, Navy, and commercial operators. If investigation indicates that a condition is apt to pass from the "isolated case" to a chronic stage, action is taken immediately.

Frequently in the course of their investigations the staff service liaison engineers hit upon new ideas for articles which should be made available to operating and maintenance personnel. The other common source of articles is material submitted for circulation by other Douglas departments.

In the normal course of events, all of the trouble reports and all of the questions from operators are answered

PROPELLER BALANCING — TITLE | LES BURCH — AUTHOR | 10-7-44 — DATE | GENERAL — CLASS. | MODEL

ROUTE			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
WRITER	L.B.																																
ART WORK	B.B.B.																																
PRELIM.																																	
TECH. CHECK																																	
CAPTIONS																																	
PROOFS																																	
REWRITE	F.L.A.	1.																															
	K.S.P.	2.																															
		3.																															
TYPE	STENOGRAPHER																																
OFFICE FINAL																																	
APPROVAL	OKLAHOMA CITY SERVICE	1.																															
CHICAGO SERVICE		2.																															
EL SEGUNDO ENGINEERING		3.																															
EL SEGUNDO SERVICE		4.																															
SANTA MONICA SERVICE		5.																															
SANTA MONICA ENGINEERING		6.																															
CHIEF PILOT		7.																															
LONG BEACH SERVICE		8.																															
LONG BEACH ENGINEERING		9.																															
EXPERIMENTAL FLIGHT		10.																															
FIELD SERVICE		11.																															
TULSA SERVICE		12.																															
REVISE	L.B.	1.																															
	F.L.A.	2.																															
	K.S.P.	3.																															
FINAL O.K.	EDITOR																																
LAYOUT	B.B.B.																																
PAGE PROOF																																	

Inter-office routing sheet for each article appearing in "Douglas Service," showing thoroughness of checking and re-checking to assure accuracy and completeness of every item.

at once by the customer service department at the plant where the model is built. The staff of the magazine receives copies of all such queries and finds them a fruitful source of possible articles, the idea being that if one operator asks a certain question it is probable that many others will need the same information sooner or later.

Regardless of the source of the idea, each article passes through the same channels. The editor assigns the subject to a service liaison engineer, who investigates its possibilities thoroughly. If an article seems warranted, every possible source of information

(*Turn to page 297*)

TITLE: PROPELLER BALANCING — MODEL: GENERAL — WRITER: L.B. — DATE: 10-15-44

ORIGINAL ART WORK

Checkers	Corrections to be made (initial and date)	Revise 1 Date:	Revise 2 Date:	Revise 3 Date:	O.K.
Writer L.B. (Return to System)	EXTEND DIMENSION LINE TO POINT A. PART NUMBER 2151706 SHOULD BE 2115706. L.B. 10-15	LOOKS GOOD NOW			L.B. 10-16
Technical Checker E.H.B. (Return to System)	O.K. AS NOTED ABOVE E.H.B. 10-15				E.H.B. 10-16
Rewriter F.L.A. (Return to System	O.K. AS NOTED F.L.A. 10-16				F.L.A. 10-17
	ENGRAVER'S PROOFS				
Writer	CLEAN UP CHECK MARKS.				L.B. 10-22
Tech. Check.					E.H.B. 10-22
Rewriter	MAKE DEGREE MARKS DARKER				F.L.A. 10-23
	CAPTION				
Fig. CUT	PROP BALANCING BOLT INSTALLATION				F.L.A. 10-22

There's extensive use of art work, for experience has proved that even complex illustrations speed service and maintenance men's work in keeping combat and transport planes aloft. This is route sheet for a single art piece, which is put through "works" at same time text material is in process.

Through use of Mobile Training Unit, graphic instruction can be carried on right alongside ships. Here, at base in England, hydraulics instructor has brought mock-up from truck to explain operation of emergency landing gear lowering device to a group of North American Mustang pilots.

FIX-IT SCHOOL *On Wheels*

By WILLIAM J. HARGEST

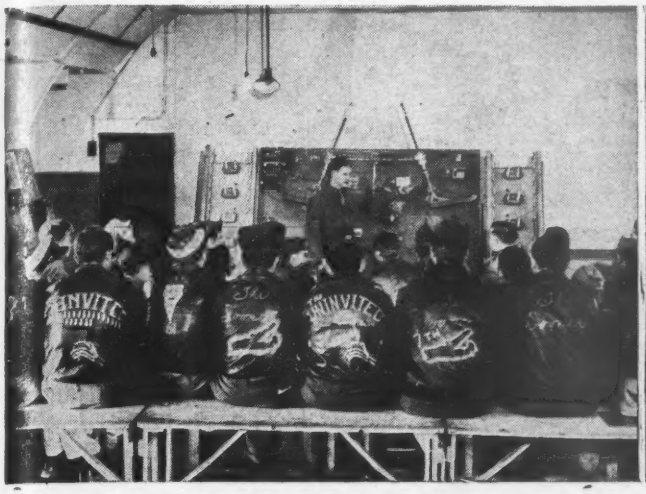
AAF's Mobile Training Units carry mockups, models, cutaways, and hookups right to the front—to see that the man-in-the-uniform knows the last word on trouble shooting.

AMONG THE HUNDREDS OF THOUSANDS of vehicles with our armed forces brought into France during the summer, one was certainly unique unto itself. It was a 5-ton trailer truck packed with crates containing mockups of the engine and operating equipment for an American fighter plane.

This vehicle was a traveling school to keep the pilots and ground crews abreast of the latest developments and modifications for this airplane, and to acquaint them with emergency procedure and trouble-shooting tricks developed out of combat experience by the pilots operating from bases in Britain.

The trailer truck rolled to the edge of an advance fighter base, and beneath camouflage netting its crew unloaded the crates, set them up in a semi-circle, and unhinged the top, front, and sides of each crate. These swung open as panels—to reveal working models of the engine, engine accessories, plane operating and control equipment, and armament. Some of the mockups have cutaway prototypes that show how the parts function. Others are complete hookups of electrical, mechanical, and hydraulic apparatus and instruments aboard the ship, all of which function exactly as they do aboard the aircraft.

While the mockups were being uncrated and arranged, the officer in



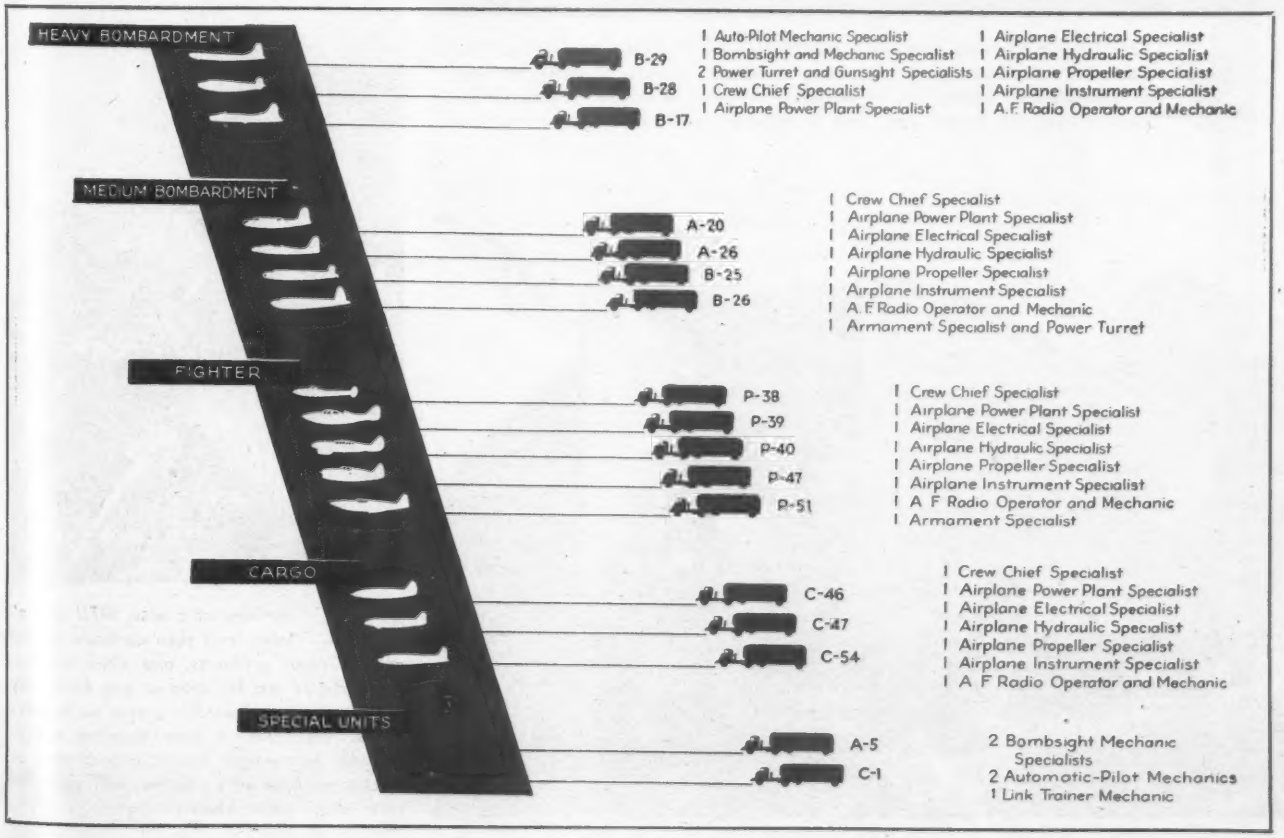
Working models of various plane units are fitted in special cases which open in panel form, ready for display and explanation. Any convenient place is suitable for a class. Left photo shows school held in Nissen hut at bomber base, where lecture underway concerns operation of emergency switch for salvoing bombs from Boeing Flying Fortress. At right, truck itself forms "backdrop" for class of ground crewmen learning intricacies of Lockheed P-38 electrical system.

charge of the mobile training unit and the commanding officer of the advance fighter base arranged a schedule for pilots and service mechanics to attend classes held under the direction of the MTU (Mobile Training Unit) crew composed of specially trained enlisted men. Classroom schedules were prepared to fit the time available, the number of men needing training and the type of training desired.

With the schedules prepared and with the mockups arranged conveniently to facilitate and speed instruction, including the use of the trailer itself as one classroom, classes commenced. And all this was done within a few hours of the training unit's arrival.

Here in France close behind the retreating Germans, with thousands of Jerries still behind our advance forces and yet to be rounded up, the pilots and service mechanics of this fighter group

Scope of MTU's organization is shown in this diagram revealing plane categories covered and complement of specialist crews carried by each instruction truck.



Top: Even a barnyard becomes a classroom when it proves handiest spot for schooling men in how plane units tick. Here, over protests of geese, workings of an American combat craft's electrical system is divulged. Below: When class is over, equipment goes back in truck to continue itinerant instruction.

were receiving the same instructions on modifications and trouble shooting as were being given to personnel still being trained in the states. Thus, education was keeping pace with the lessons learned in combat—education directly under the enemy's guns.

Today, many other mobile training units are functioning with our air forces at the front. Ten mobile training units were initially sent to the European Theater last March. Additional units have since arrived, making a total of approximately 38 units.

In England there are nine Boeing B-17 units, seven Consolidated B-24 units, five Republic P-47 units, five North American P-51 units, two Lockheed P-38 units, one Martin B-26 unit, and one Douglas A-20 unit; in addition, there are two automatic pilot units, one Sperry and one Minneapolis-Honeywell. Of this total, 28 operate with the 8th Air Force and 10 with the 9th Air Force. While in this theater, they are controlled by the Air Service Command, USSTAF (United States Strategic Air Forces), but they receive their movement orders, housing, messing, and housekeeping functions from the using Air Force.

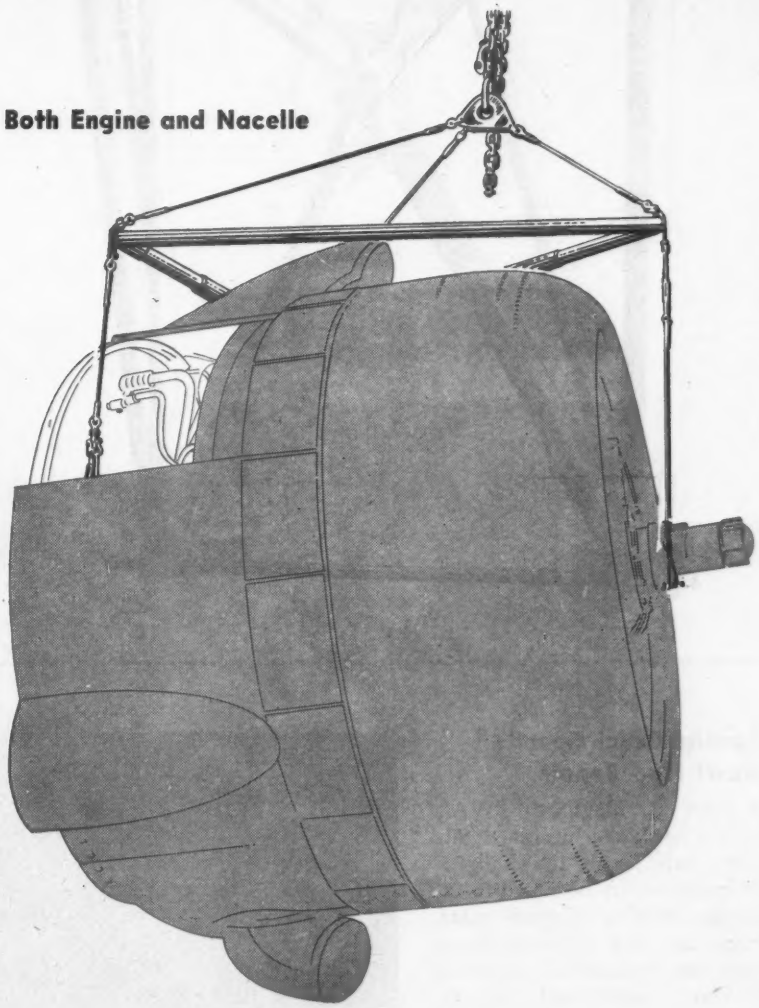
More than 100 MTU's are touring bases in combat theaters and in the United States. Practically every make of American aircraft is represented. Some of the units are built on con-

(*Turn to page 279*)

Arriving at a base, MTU men always level their curricula against specific local problems, and when solutions or short-cuts are hit upon at one field, they see that the good word is passed on to other fields. Instructor is seen pointing out to sergeant how washer placed in well shaft of discharge nozzle of carburetor will cure fuel leaks which cause abortive flights.

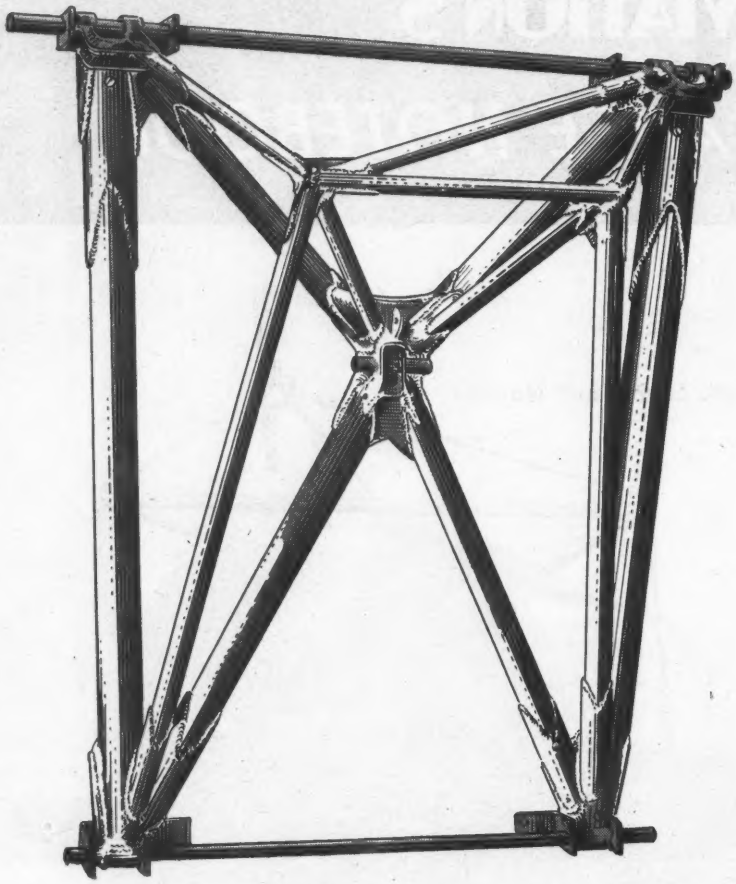
AVIATION'S MAINTENANCE NOTEBOOK

Special Sling Handles Both Engine and Nacelle



• Jack Edwards, foreman of engine installation at Delta's Atlanta shops, invented this sling for removing both engine and nacelle as a single unit. Weighing but 18 lb., this useful device can be carried by one man. Padded clamp for engine shaft is self closing when load is applied, while other two attachments are of looped-cable type, thus can be connected by one hand.

AVIATION'S MAINTENANCE NOTEBOOK

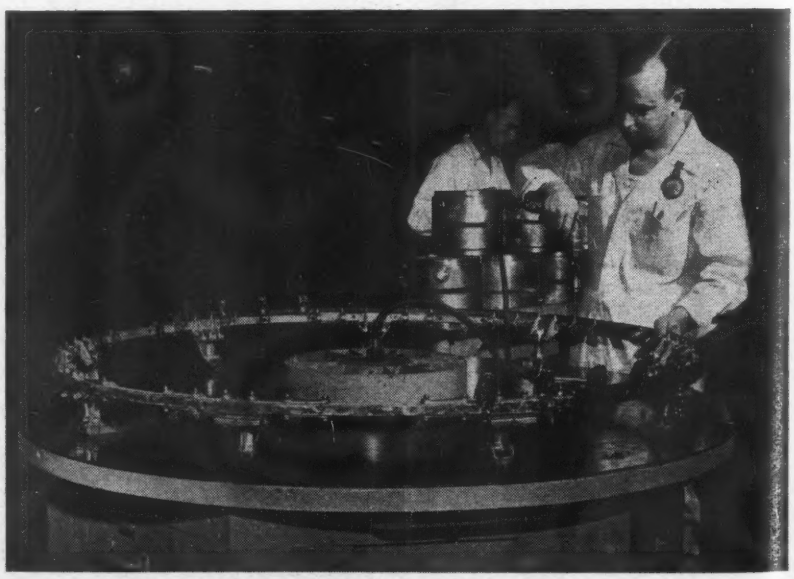


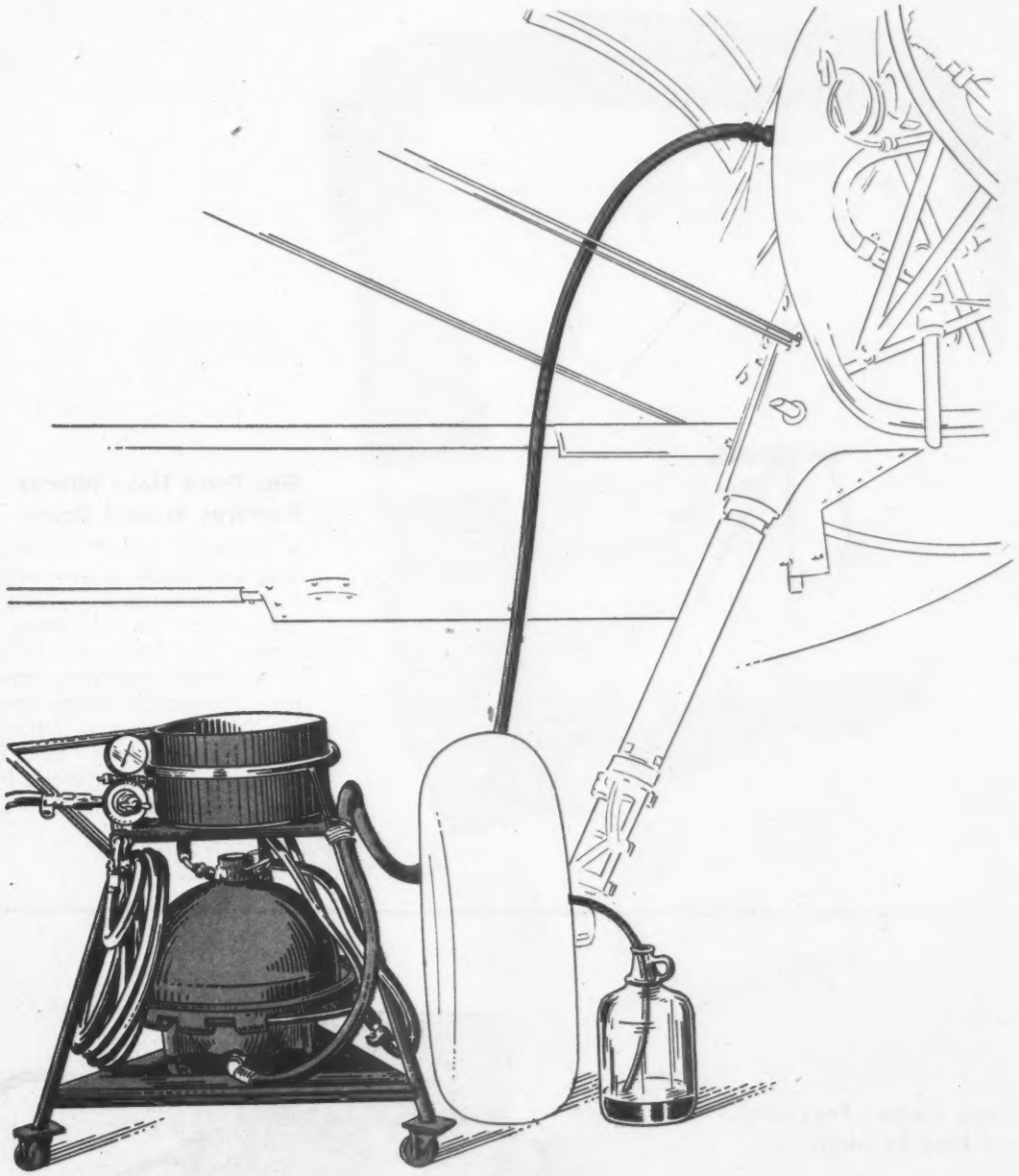
DC-3 Strut-Checker Simplifies Procedure

• Pan American uses this device to check landing gear struts before putting them in place on plane. Base is a steel plate fastened to wall. Precisely drilled angle brackets, through which pins are passed, serve to indicate if each part is in line. It is planned to add additional brackets to align hole in center.

Special Bench Speeds Cowl Flap Repair

• John M. Haggard, TWA's senior mechanic, designed this cowl flap bench to eliminate dragging of air hose and to facilitate locating of small parts. Short air hose in center keeps hose out from under foot, while revolving partitioned tray enables worker to find any small part he requires. Tools are kept in lockers beneath bench.

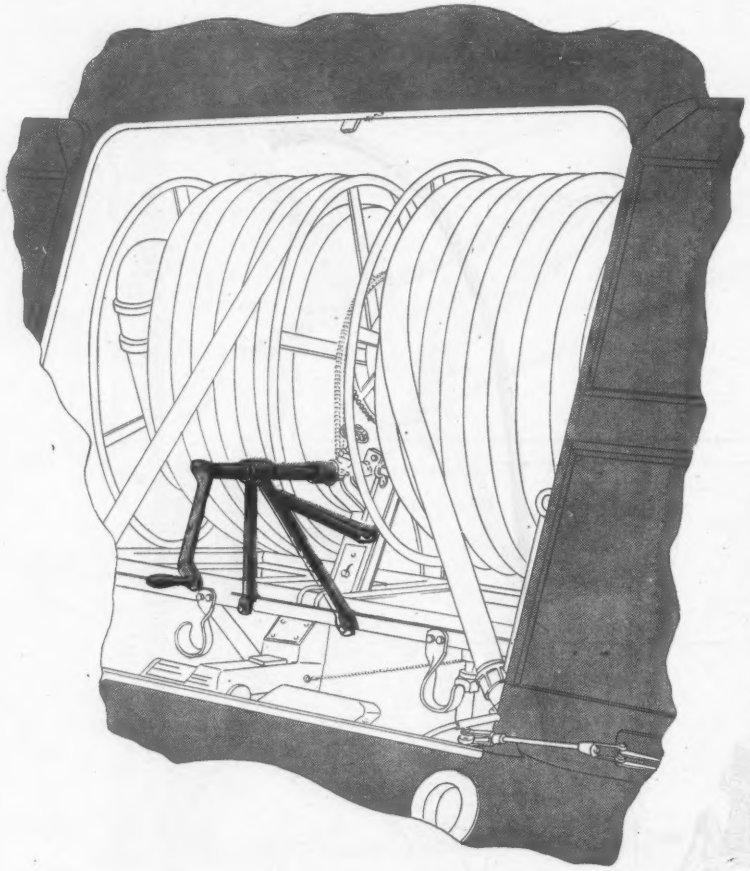




One Man Handles This Simplified Brake Bleeder

• Brake bleeding on PT-17's formerly required time of three men for 5 min., but by using this gadget, built by Rankin Aeronautical Academy, one man can do job in little more than 1/5th total time of old method. Made from salvaged parts, bleeder is used with 50 psi. air, taken through regulator at top. Fluid line is attached to top of brake cylinder by threaded fitting. A small valve in line stops flow when no more air bubbles appear. In operation, bleeder hose is screwed into wheel cylinder fitting, main fluid hose is connected to top of master cylinder, and valve is opened. Fluid under pressure is let into master cylinder, and a valve at wheel cylinder permits oil to flow through entire system until no more air is seen to escape. Wheel cylinder valve is first closed, then valve in main fluid line. Outfit is easily moved on castered wheels.

AVIATION'S MAINTENANCE NOTEBOOK

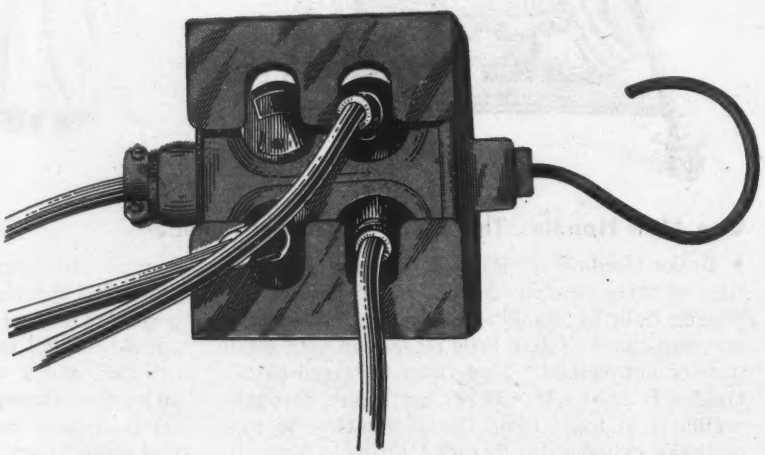


Gas Truck Hose Winder Features Braced Crank

• Formerly forced to support weight of crank while rewinding hose on gas trucks, UAL's mechanics now use hand crank supported by two-pronged brace shown here, saving two-thirds of time and doing a neater rewinding job, because two hands may be used to guide hose. E. C. Berr, UAL's lead mechanic at San Francisco, invented device.

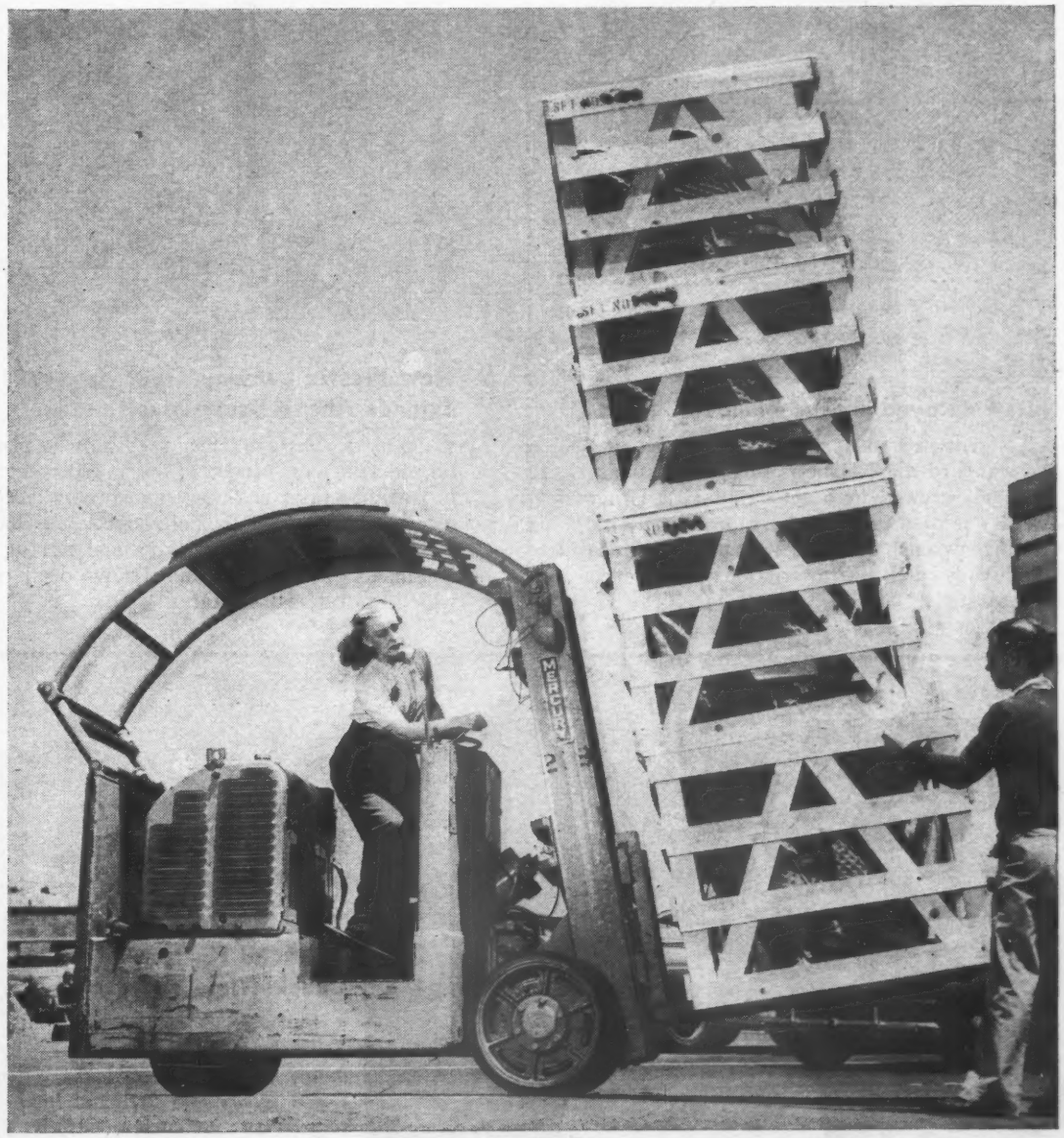
Hinged Holder Prevents Cord-Plug Troubles

• Albert J. Rogge, Bruning, Neb., AAF mechanic, prevents cord plugs from being pulled out—by means of this hinged holder, which overlaps plugs and avoids trouble caused by connections being broken when cord is accidentally jerked. Spring hinge permits raising of flap to make or break connections.

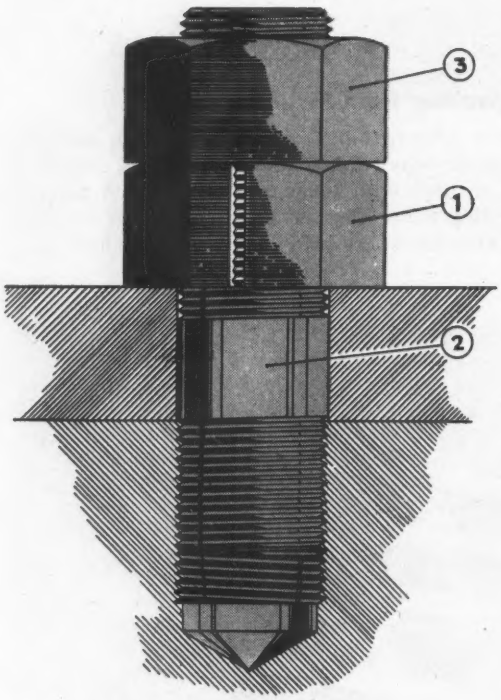


Guard Protects Operator from Falling Loads

• Constructed of heavy tubing, this device protects truck operator from accident in event of heavy load falling backwards. Hinged at both ends, guard is fitted with linkage at rear which permits tilting of forward hoisting unit. Devised by Douglas, this idea has many applications at airports where heavy loads are handled.

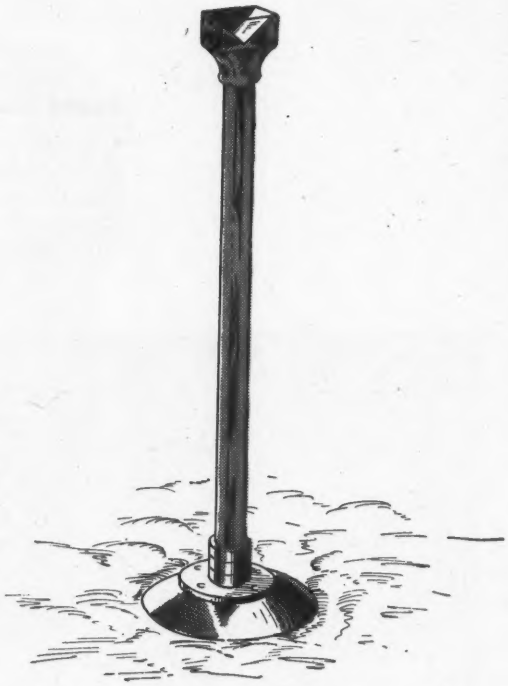


AVIATION'S MAINTENANCE NOTEBOOK



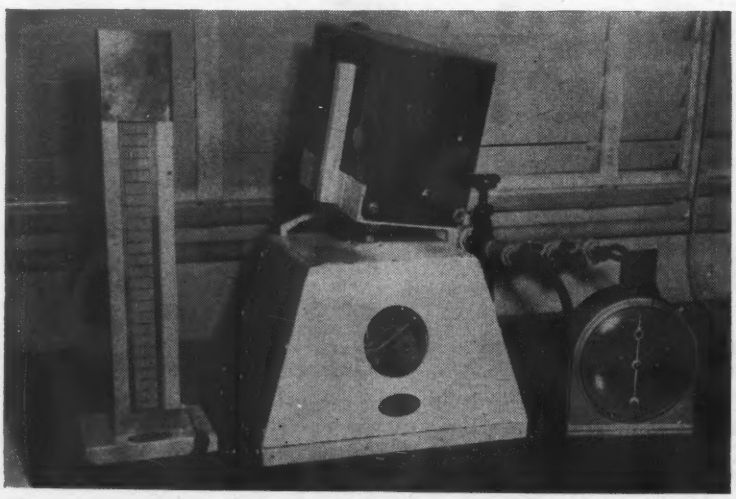
Nuts Employed in Stud Removal

• To remove studs, General Electric uses two standard nuts. One is slotted lengthwise (1) and screwed first onto stud (2). Other nut (3) is then jammed down on slotted one, to which wrench is applied. Split nut binds on threads and extra friction turns even tightest studs.



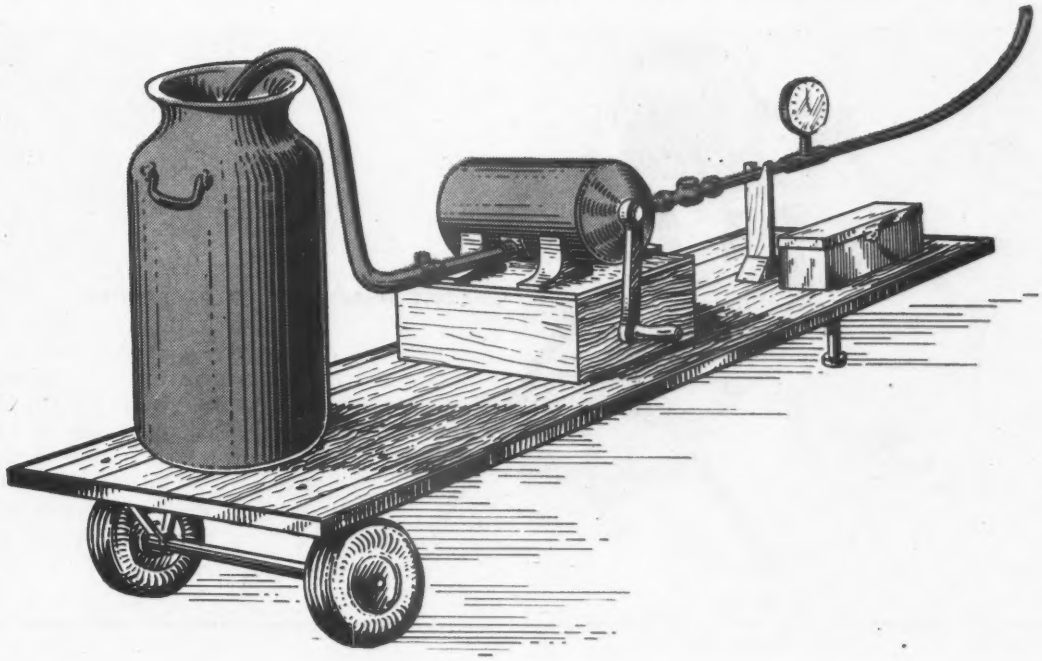
New Plastic Runway Light Extends Above Snow Level

• To mark runways under deep snow, a plastic rod unit with prismatic top to reflect light in two directions has been invented by Technical Development Division of CAA. Rods screw into usual flush sockets and are of a length to extend above any snow depth in which aircraft can operate.



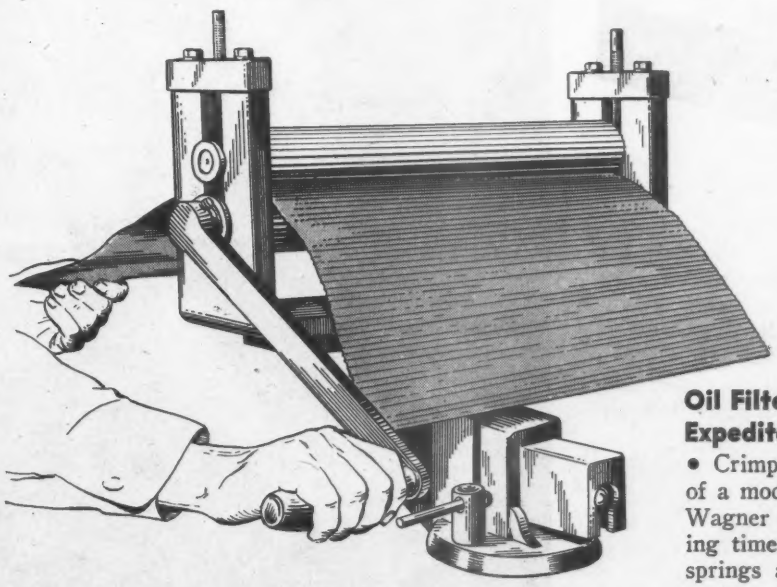
Artificial Horizon Tester Checks Time and Pressure

• Pan American made this Scoresby-type tester with tab motor in base for testing directional gyros and artificial horizons. With manometer (left) and timer (right) both time and pressure can be checked during tests.



Portable Pre-Oiler Rig Doubles for Pressure Work

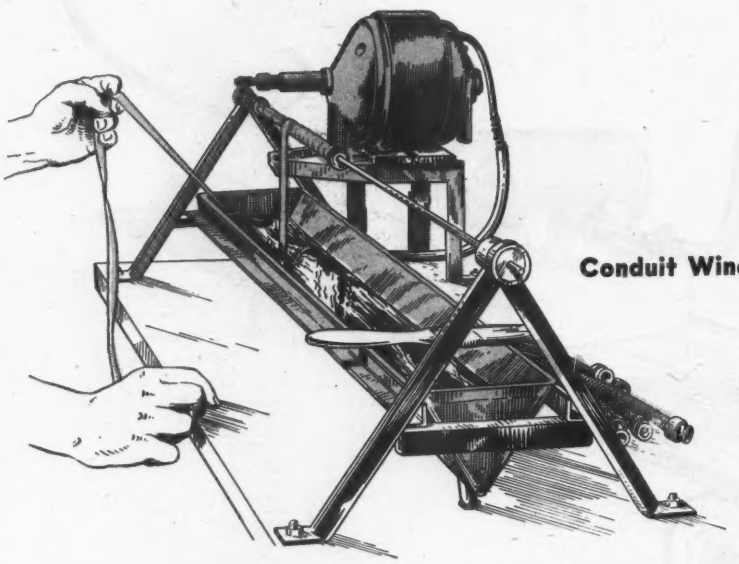
• Using a hand-driven pressure pump of either vane or gear type, this pre-oiler can be moved any place where it is needed. Five-gallon container can be heated with blowtorch without danger of fire. When fitted with pressure gage, rig has many other uses as pressure testing device.



Oil Filter Screen Roller Expedites Repair Work

• Crimping of filter screens by means of a modified wringer, J. C. Goolsby, Wagner Robins ASC, eliminates waiting time and expedites repairs. Coil springs above bearings give uniform pressure during operation.

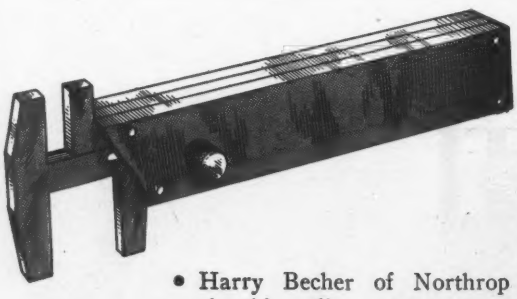
AVIATION'S MAINTENANCE NOTEBOOK



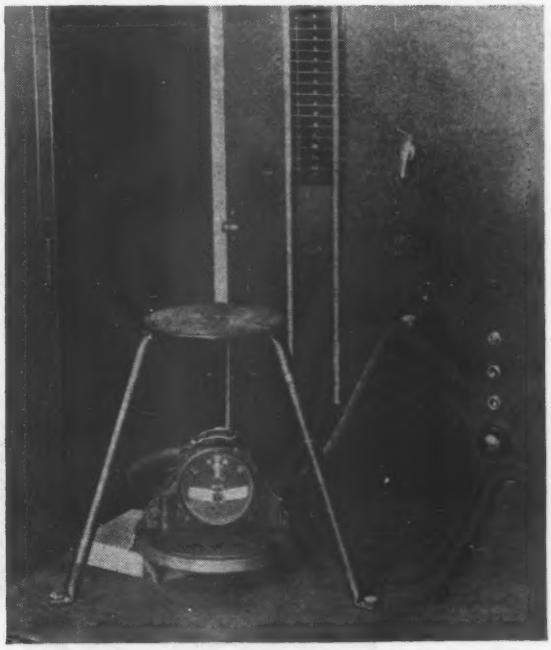
Conduit Winder Brings Economies

• By using an electrically driven conduit winder for covering ignition leads with doped, pinked tape, Charles Donovan of PCA saves 50 percent of time formerly expended. Conduit is placed on mandrel, while tape passes under a bar in trough of dope, then up to conduit on which it is wound.

Router Caliper Prevents Mistakes

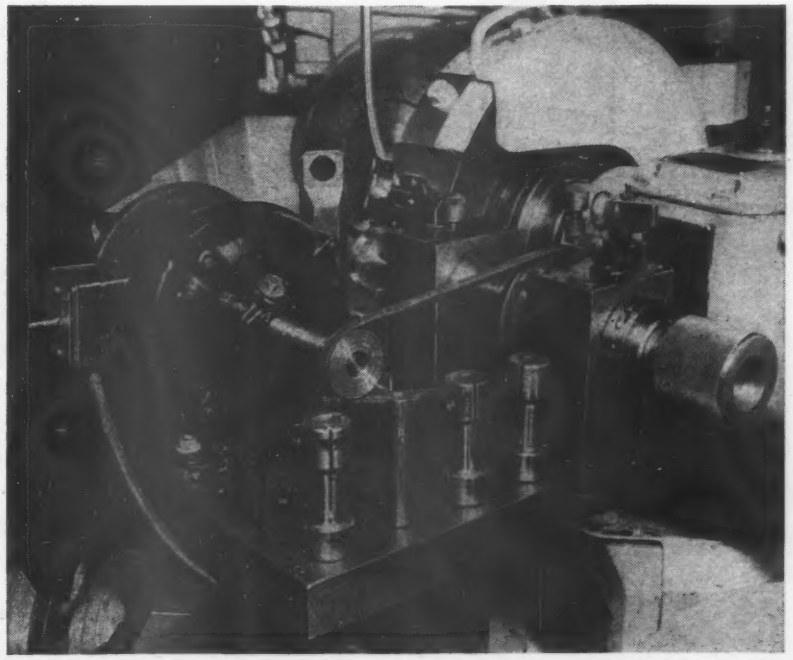


• Harry Becher of Northrop made this caliper to speed up work and curb errors in choosing correct relative sizes of router cutters and pins. When open jaw is set to cutter size, diameter of pin is given by opposite jaw.



Special Scoresby Tests Gyro Horizon or Bank & Turn

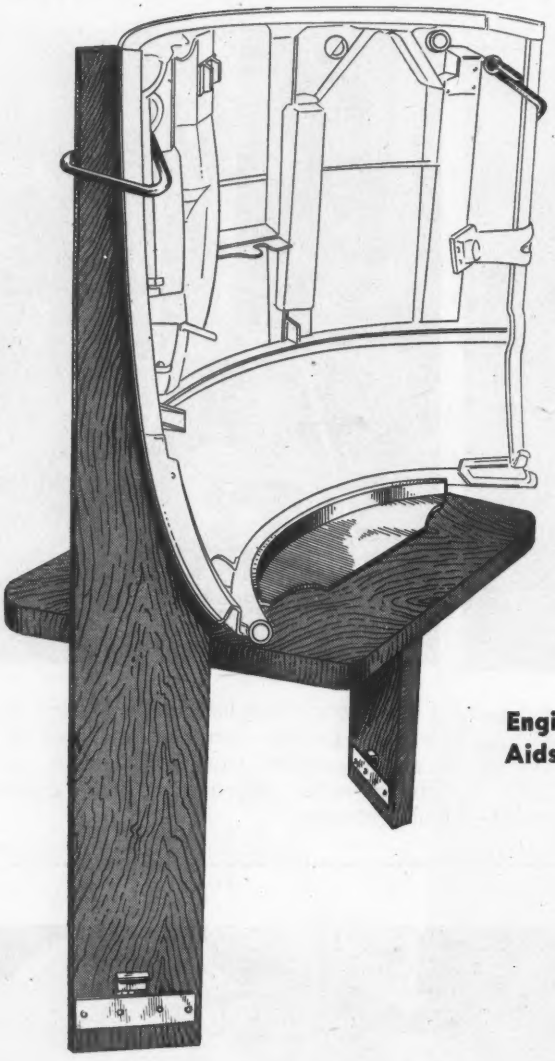
• Operated by electric motor beneath bench, this two-position bank-and-turn and gyro-horizon Scoresby used by C. & S. obtains its rolling motion from round plate with several holes at different radii. Air hose at right supplies motive power for instruments.



Valve Refacer Has Special Features

• Supplied with collets split from both ends to afford better and more accurate grip, this heavy duty valve refacer, used by TWA, has a 12-in. grinding wheel operated by motor separate from that which turns valve. Indicator (seen above valve) shows face accuracy to .0001 in. Heavy bronze bearings on 1¾ in. shaft give rigidity to valve, eliminating chatter.

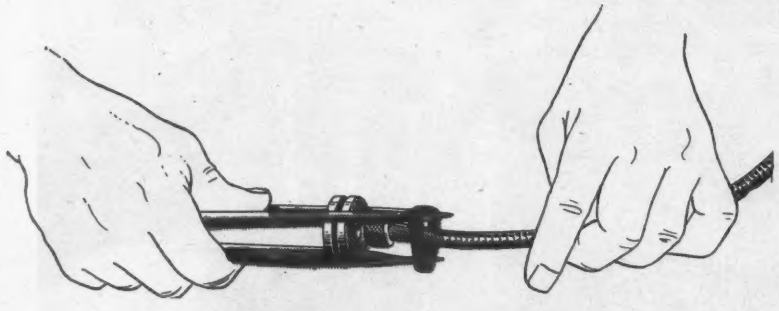
AVIATION'S MAINTENANCE NOTEBOOK



Engine-Cowling Bench Aids in Riveting

• United Air Lines uses this bench for holding curved cowl plates while riveting. Lower shelf both holds tools and steadies work. Invented by company mechanics, this simple device saves much time while affording a firm support for otherwise hard-to-hold parts.

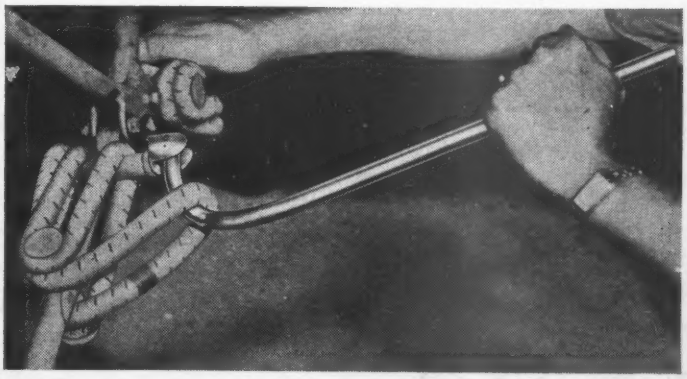
Grommet Stretcher Speeds Production



• Curtiss-Wright saves time, fingers, and material by using simple three-pronged tool shown here. Grommet is stretched without damage and released when in place.

Soviets Use Truck Rig As Starting Booster

• When winter cold slows "turn over", Soviet airmen use special-rigged truck for starting booster. Mechanic stands on platform on front of truck and engages motor-driven shaft with propeller. Truck's headlights illuminate job. (Sovfoto)

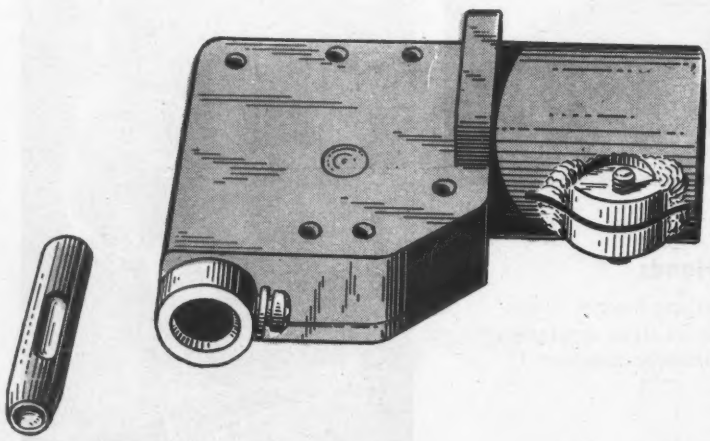


Rubber-Stretching Jimmy Saves Hands

• Eliminating danger and lost time in fitting bungee shock-absorbers to landing gear or tail wheels of light airplanes, this tool does work in 2 min. which formerly required 15.

Shock-Strut Oiler Bleeds and Fills at Once

• P. V. Chaffee, Clintonville, Wis., airport manager, uses this tank for air-bleed and shock-strut filling. Hydraulic fluid is kept under pressure in tank, being fed from bottom to lower end of strut. Air escapes at top until fluid appears, when outlet is closed and pressure built up in strut cylinder to required point. By this means two operations—bleed and filling—are completed at same time.



Hammer Attachment For Right-Angle Riveting

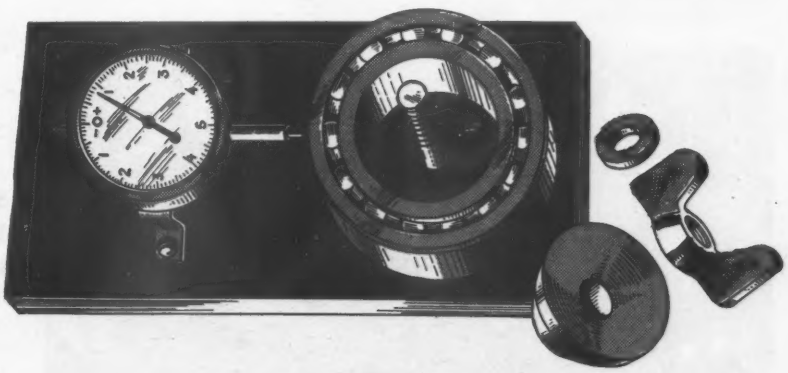
• At Ogden ASC, Raymond Eaton, of sheet metal department, made this hammer attachment to reach formerly inaccessible places. Cover houses plunger actuated by hammer. Curved and pivoted hammer, driven by plunger, drives second, slotted plunger (shown at left). Attachment takes place of 90-deg. gun, has saved much time and material.

G. I. Sergeant Builds Time-Saving Tire Remover

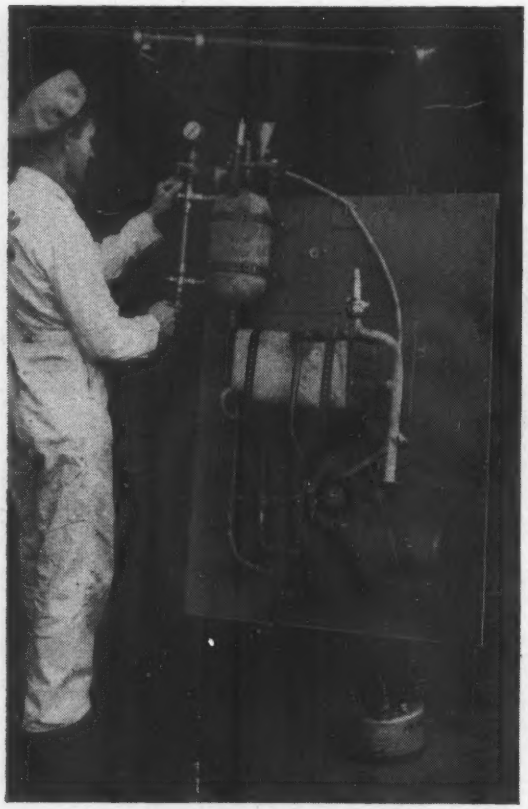
• Master Sgt. Walter M. Baluka, in charge of U. S. Army welding depot in Italy, invented and built this hydraulically operated attachment to a commercial tire remover, using an old aircraft hydraulic cylinder and such odd parts as he could salvage. Hand pump is supplied from reservoir near top of cylinder. This device has saved much time in removing heavy aircraft tires. (British Combine photo)

Simple Dial Unit Checks Bearings

• Ball and roller bearings are checked in this simple device, made at UAL's Cheyenne shops. Bearing is centered by conical washer, tightened by thumbnut. Any eccentricity is shown on indicator dial.

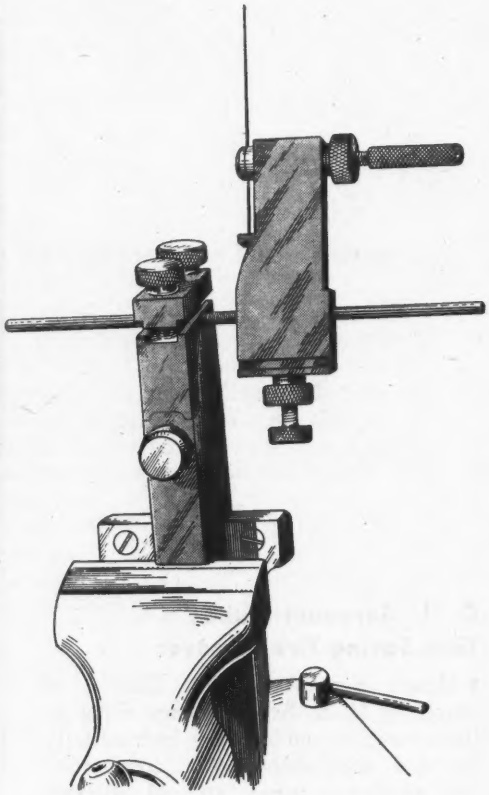


AVIATION'S MAINTENANCE NOTEBOOK



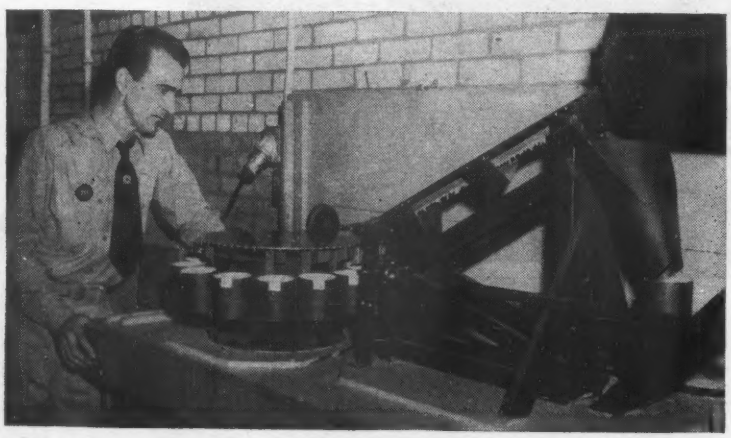
DC-3 Heater Mockup Simplifies Instruction

• To instruct mechanics in upkeep and inspection of DC-3 heating system, C & S built this mockup, enabling entire installation to be demonstrated more effectively, and in far less time, than would be possible in plane itself.



Coiler Device Makes Odd-Size Springs

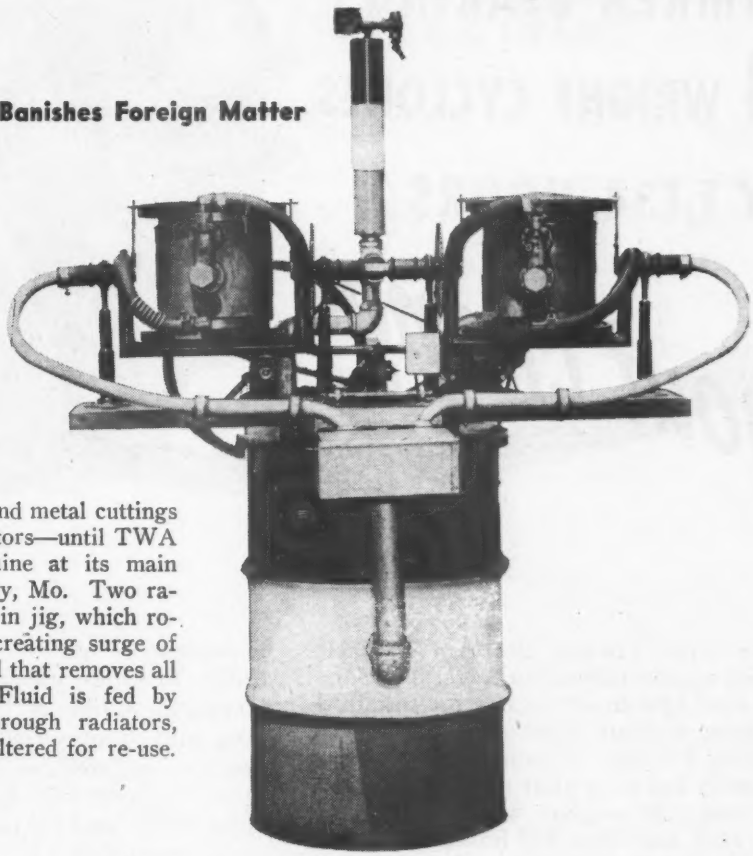
• Perley B. Ramsey, instrument mechanic in ASC Mobile Unit, designed this machine for making springs in sizes not usually available. Made with changeable core, winder has capacity running from 1/64 in. i.d. to 1¼ in. i.d. Setscrew on handle governs tension of spring wire being wound.



Special Sorter Saves 17,000 Rivets Hourly

• Dumped into hopper (at right in picture) rivets are sorted at rate of 17,000 per hr. by this machine. Inventor is Edward J. Mayes, Pan American's assistant chief of metal shop at N.Y.C. Clipper terminal, who is here shown operating apparatus.

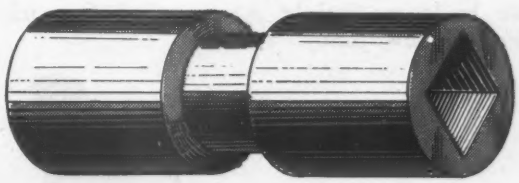
Oil Radiator Washer Banishes Foreign Matter



• Carbon, slugs, and metal cuttings stayed in oil radiators—until TWA devised this machine at its main base at Kansas City, Mo. Two radiators are placed in jig, which rotates in half arc, creating surge of oleum and Penetrol that removes all foreign matter. Fluid is fed by pressure pump through radiators, after which it is filtered for re-use.

Rivet Remover Is Handy Tool

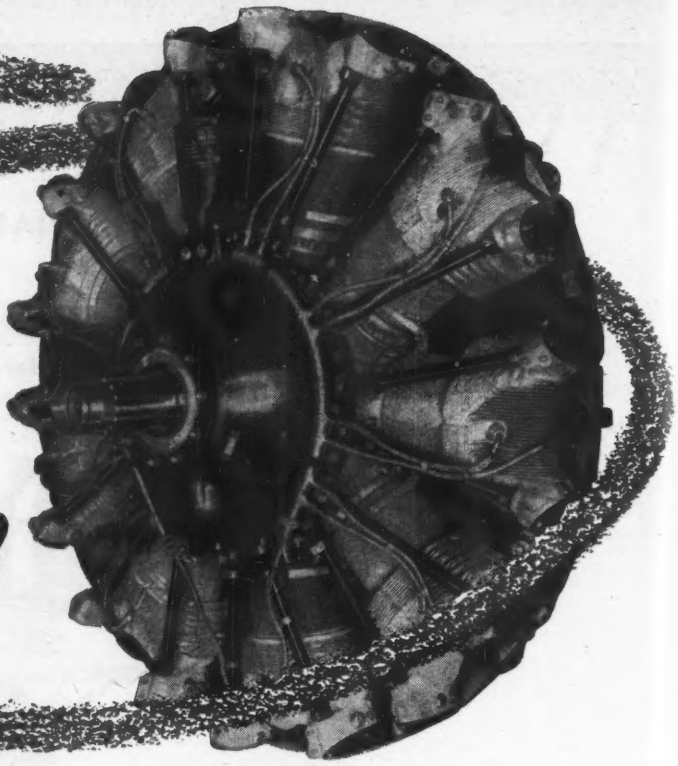
• Sacramento ASC mechanics developed this handy tool for taking out rivets when repairing or salvaging aircraft. Rivet is pressed out with small punch, while flat surface at bottom supports metal as rivet is squeezed through hole in center.



How Taps are Saved by Plastic Extension

• By using a Zamak plastic extension between chuck and tap, breakage of taps has been eliminated at Glenn L. Martin. Undue stress breaks neck of Zamak extension, and tap is then cleared by hand without damage to either work or tool. Before adoption of this device, tap losses caused serious bottlenecks in many parts of the plant, further resulting in loss of materials. Device was invented by Supervisors Stull, Lang, and Lapoz of company's Baltimore plant.

TIMKEN BEARINGS IN 4 WRIGHT CYCLONES FLY 1,134 HOURS *without change*



Equipped with Timken Bearings in their intake and exhaust valves, four Wright Cyclone Engines have broken all records for sustained performance without overhaul on a Boeing B-17 Flying Fortress. In doing it, they flew 200,000 miles and were aloft more than 47 full days of time. The engines were removed for overhaul only after they had broken the previous sustained performance mark by 59 hours.

"Timken Rocker Arm Bearings were in the intake and exhaust valves of *all four engines without change during operation,*" points out the builders, Wright Aeronautical Corporation of New Jersey.

Endurance is not the only quality Timken Roller Bearings impart to aircraft engines. Compactness, light weight, freedom from friction, smooth operation, economy of maintenance — as well as maximum radial and thrust load-carrying capacity are other advantages which enabled this outstanding record to be established.

These indispensable bearing features can help you meet your aircraft requirements. Write us, we'll be glad to make recommendations. The Timken Roller Bearing Company, Canton 6, Ohio.

COMPRESSIBILITY CALLS A CHALLENGE*

By **COSTAS ERNEST PAPPAS,** *Chief of Aerodynamics, Republic Aviation Corp.*

A clear, concise analysis of basic factors in new but increasingly important problems affecting design and production of high-performance aircraft.

PROBLEMS ASSOCIATED with high-speed flight are manifested because air is compressible—and these problems are, in truth, very complex.

Compressibility is the term which aeronautical engineers use for a large class of aerodynamic effects associated with high speed. This designation has been adopted because changes which occur in fluid flow at high speeds are chiefly produced by the elasticity or compressibility of the air. If air were an incompressible medium, these effects would not be present. Associated with compressibility is the density of air, which changes rapidly, in turn causing the airflow to change over the surface of the body.

At speeds approaching that of sound —approximately 760 mph. at sea level —the aerodynamicist is confronted with the problem of the airflow changing in character due to rapid changes in density resulting from compressibility properties of the atmosphere.

The practical significance of compressibility effects to aeronautics lies in the fact that the lift and drag of supporting surfaces, the effective operation of control surfaces, and the operation of the propeller with respect to efficiency and capacity, are all affected since the actual fluid is compressible. The lift, drag, and moment of a body are functions of the ratio of speed of the body to the speed of sound at the altitude in question. This ratio is called the Mach number after the Austrian physicist, Ernest Mach, who specialized in the study of high speed phenomena.

A rather abstract appreciation of the foregoing is afforded by a consideration of the elementary forces acting on a fluid particle. For our purposes it suffices to name principle forces.

First, is the well-known D'Alembert force of acceleration. This force is proportional to the square of the velocity with which the particle executes its motion, and the mass of the particle. Evidently the force is very small unless the velocity is high, but the force increases very rapidly as the velocity is increased.

Second, is the force of pressure acting differently on opposite sides of the particle. This force serves to balance the D'Alembert reaction. It is therefore called into being by the motion, and it disappears when the motion ceases. Let us agree that viscosity forces are small and may be neglected within the first order approximation.

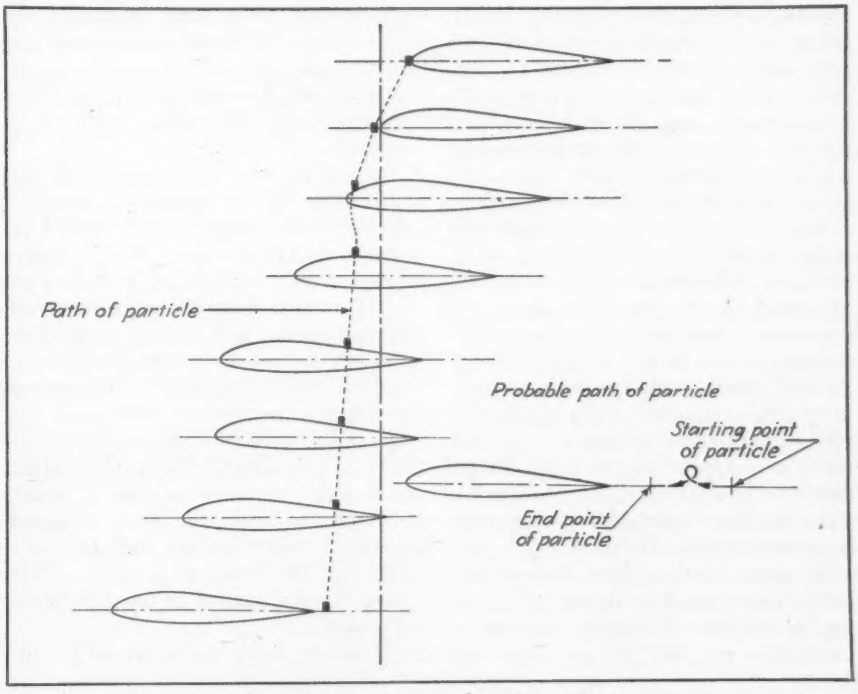


Fig. 1. Diagram showing probable path of air particle over top surface of airfoil.

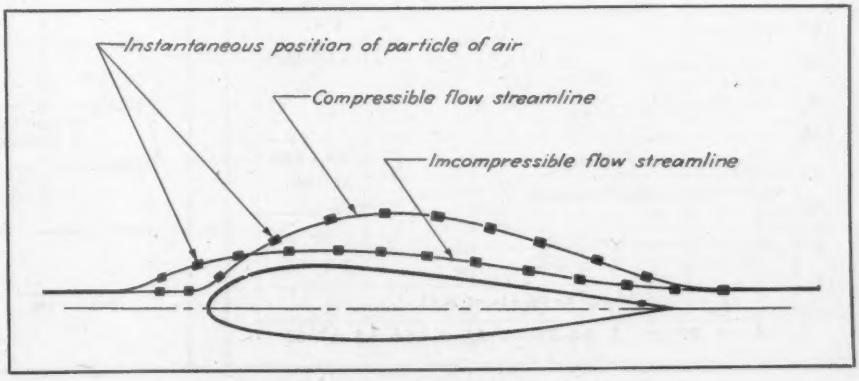


Fig. 2. Comparative position of streamline for compressible and incompressible flow.

* Based on a paper presented before the Albany Society of Engineers.

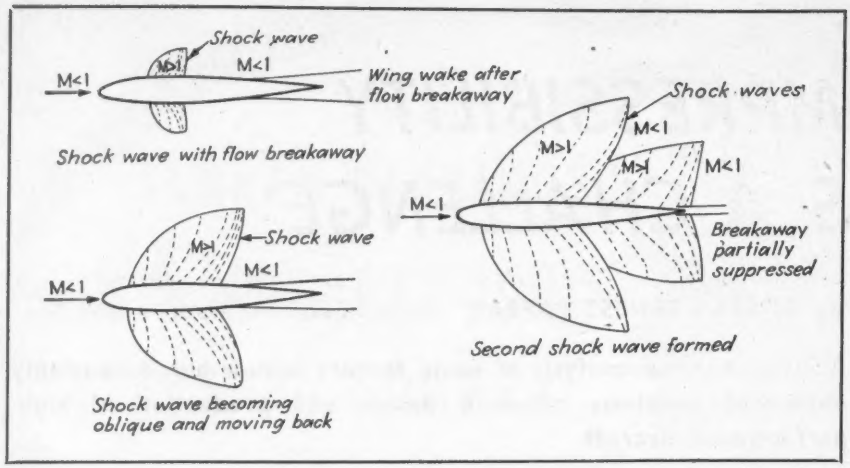


Fig. 3. Illustrations of shock wave patterns for airfoil as Mach number approaches unity.

Our picture now is of a particle of fluid executing an irregular motion in such a way as to avoid an airfoil which moves through the region initially occupied by the particle (Figs. 1 and 2). Since the particle is accelerated from rest and follows an irregular path thereafter, a complicated system of inertia forces appears on the moving particle. These forces are balanced by pressure differences which appear between different points of the fluid.

Since inertia forces are small with small accelerations, we expect small pressure differences at low speeds. However, as the speed increases, the pressure forces required increase according to the square of the velocity. At sufficiently high speed these pressure differences will theoretically exceed atmospheric pressure, and vacuums may appear in the flow. In the case of a comparatively incompressible fluid, such as water, this phenomenon is usually called cavitation.

However, with a fluid, such as air, which can expand to fill any space, we find a different situation. Instead of cavitation we find the air becoming more and more attenuated in the regions of low pressure. Unfortunately for the mathematician the attenuation of the air lessens the density, so that the inertia forces are decreased, in turn decreasing the required pressures, thereby unbalancing the force system, causing the flow to undergo further readjustment, etc. This ends in a headache.

In addition to the expansion of air in regions of low pressure, a second phenomenon occurs at the speed of sound. It can be shown, theoretically, that a steady reciprocating motion of a piston in a pipe can be maintained without energy loss so long as the motion is below a certain frequency. Above this frequency, increasing amounts of energy are sent down the pipe in the form of sound waves. Similarly, at low speeds, the steady motion of a body requires no energy input, while at and above the speed of sound energy is continuously radiated outward in the form of a wave. This wave is very similar to the bow wave of a boat.

However, such waves would be unimportant at present-day speeds were it not for the fact that a complicated interaction occurs between the first phenomenon of fluid expansion and the second phenomenon of wave motion. This interaction causes the shock waves which occur approximately midway of the length of the airfoil chord (Fig. 3). An example of very similar occurrence is given by the well-known hydraulic jump in the spillways of dams. Theoretically, little can be said about shock waves, but from a practical aspect they cause much greater headaches than either of the first two phenomena.

The task of estimating compressibility effects from a mathematical viewpoint presents many interrelated difficulties such as:

(1) Absence of exact mathematical solutions of practical interest.

(2) Questionable convergence of approximate methods.

(3) Uncertainty as to the criterion for occurrence of shock waves.

(4) Considerable inaccuracy of experimental verification.

When mathematical studies are made, a steady adiabatic flow-field of an ideal gas about a two-dimensional body is assumed. When shocks are present, the assumption of irrotationality no longer exists.

Through the demands of structural and aerodynamic design, the interest of airplane manufacturers has become more and more sharply focused on the attempts to find a satisfactory and practicable solution to the problems outlined previously.

Pressure Distributions

We shall start with the diagram of pressure distribution over a wing as obtained from low-speed wind tunnels. The pressures are proportional to the velocity squared.

On this basis then, the higher the

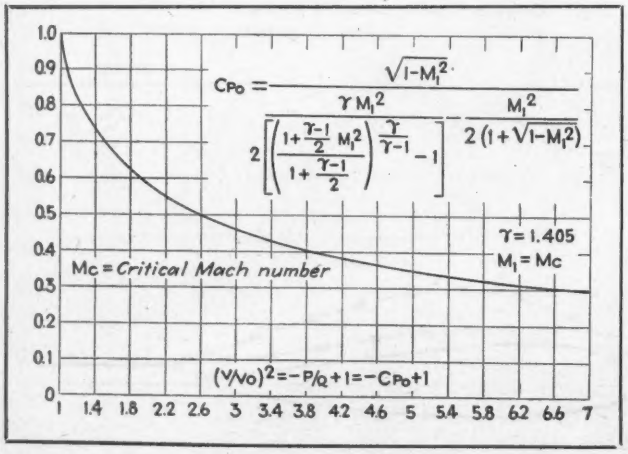


Fig. 4. Graph of airfoil critical velocity vs. maximum pressure coefficient.

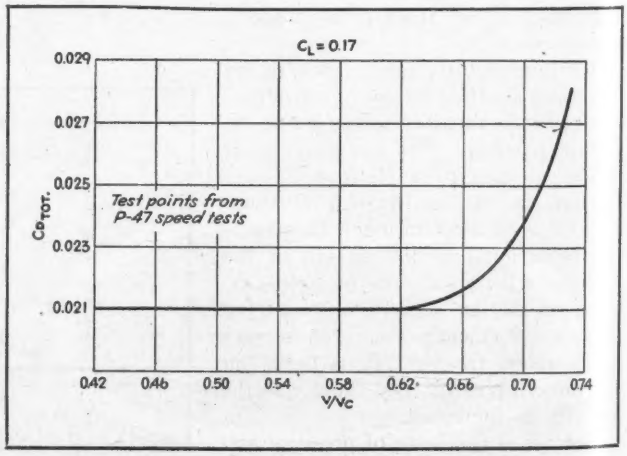


Fig. 5. Apparent variation of total drag coefficient with Mach number.

pressure, the higher will be the local velocity, and as a result, the sooner we will run into trouble. (Fig. 4). This suggests immediately that we should be very careful of curvature. The smaller the curvature, the better will be the flow conditions over the body. Small radii of curvature should be avoided when designing radial engine cowls, airfoil sections, canopy, and fuselage lines. It is important that the fuselage lines be as nearly straight as possible in the vicinity of the wing juncture, since we have superposition of fuselage and wing airflows.

Efforts to determine, theoretically, the influence of the Mach number on the pressure distribution and total lift of a wing have already been made. The answer, although not applicable up to the speed of sound, is relatively simple. The expression determined by Glauert-Prandtl is as follows: Increase all ordinates of the airfoil by $1/\sqrt{1-M^2}$. The air forces are then equivalent to those of an incompressible flow acting on the modified profile.

In particular, since angle of attack and camber also increase with the factor $1/\sqrt{1-M^2}$, the lift will increase proportionately to $1/\sqrt{1-M^2}$. The drag will increase in degree indicated by the increased angle of attack and especially the increased thickness of the profile. Such conditions apply only in the case of relatively low Mach numbers, for example, up to M=0.6. Thick profiles, however, should be avoided. According to the factor $1/\sqrt{1-M^2}$, we have for M=0.6 (i.e., V=455 mph. at sea level) a profile with 15 percent thickness would correspond to 18.8 percent thickness in an incompressible flow. Such a thickness ratio, however, is known to have appreciably greater profile drag. In order to possess good characteristics, the thickness ratio of a high-speed profile should not exceed 12 percent.

The actual critical effect of compressibility begins at values of M exceeding 0.65 at moderate values of lift of the airfoil. The streamline shape now breaks down completely, and the drag coefficient increases rapidly with increase of the Mach number; for example, between M=0.60 and M=0.75, the drag of a 12 percent symmetrical profile increases tenfold and the lift breaks down.

It is of interest to point out that when the fluid attains the local speed of sound, the airflow does not necessarily break down. In all probability a weak shock wave comes into the picture at this point, which is not too detrimental to the flow. However, as soon as supersonic regions appear, discontinuities may occur in which the velocity drops and the pressure rises over a very small distance.

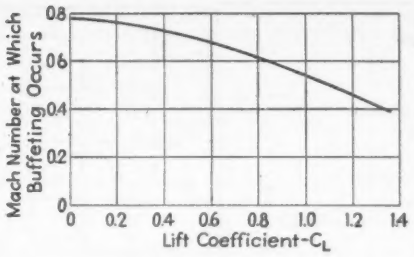


Fig. 6. Variation of lift coefficient with critical Mach number at which buffeting occurs.

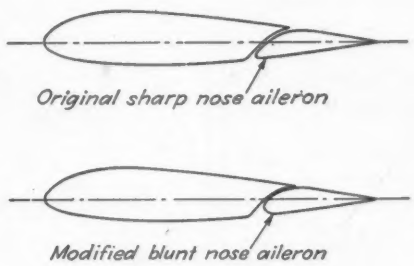


Fig. 7. Comparison of sharp and blunt nose ailerons.

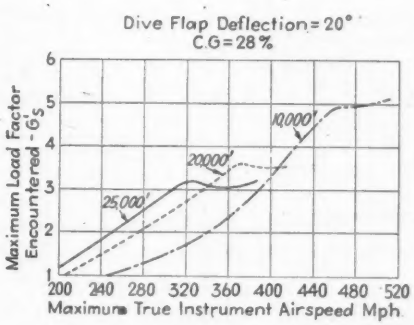


Fig. 8. Graph of maximum load factor encountered in pullout vs. maximum true instrument airspeed.

When the intensity of the shock wave increases (by intensity we mean the ratio of the pressure ahead of the wave to the pressure behind the wave), rotationality of the field sets in and a turbulent flow region exists behind the wave. These waves extend a finite distance into the free flow and then fade away. The intensity of turbulence increases with the intensity of the shock wave. These compression shocks involve the dissipation of mechanical energy resulting in an increase in entropy. Eventually separation sets in, especially at the higher angles of attack, and at this point the drag increases precipitously (Fig. 5) and the lift decreases rapidly.

With the introduction of separation, the wing circulation is decreased with the resultant loss in CL_{max}. The turbulent field existing behind the shock wave will cause the tail surfaces to buffet and fast planes will be limited in high speed because of buffeting (Fig. 6). The location of the horizontal tail surfaces is of paramount importance, and it is very difficult to position the horizontal tail so that it will be out of the wing wake, particularly so since the wing wake thickness increases appreciably when rotationality of the field sets in because of the shock wave.

In the case of projectiles, it is well-known that drag coefficient increases abruptly with approach to the speed of sound. It is now recognized that this is a phenomenon of general application, but that it is more pronounced in the case of airfoils and fuselages than in projectiles, since in the former, the initial drag is proportionately less because of favorable shape for the lower speed range.

The maximum speed of aircraft will probably occur at sea level since the maximum speed of sound occurs there. We can therefore expect a top speed of between 650 to 685 mph. at sea level. This corresponds to M = 0.85 and

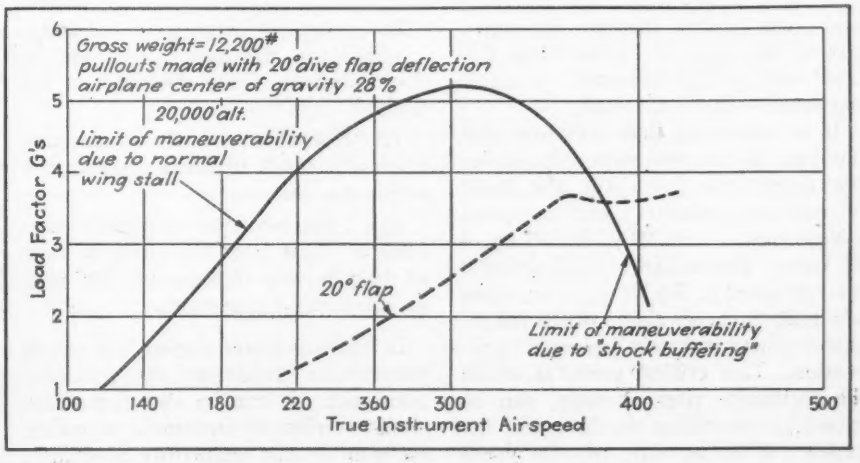

Gross weight = 12,200#
pullouts made with 20° dive flap deflection
airplane center of gravity 28%
20,000' alt.
Limit of maneuverability due to normal wing stall
20° flap
Limit of maneuverability due to "shock buffeting"
Load Factor G's
100 140 180 220 260 300 400 500
True Instrument Airspeed

Fig. 9. Velocity acceleration diagram obtainable with dive flap, showing limitation on load factor as a result of compressibility stall.

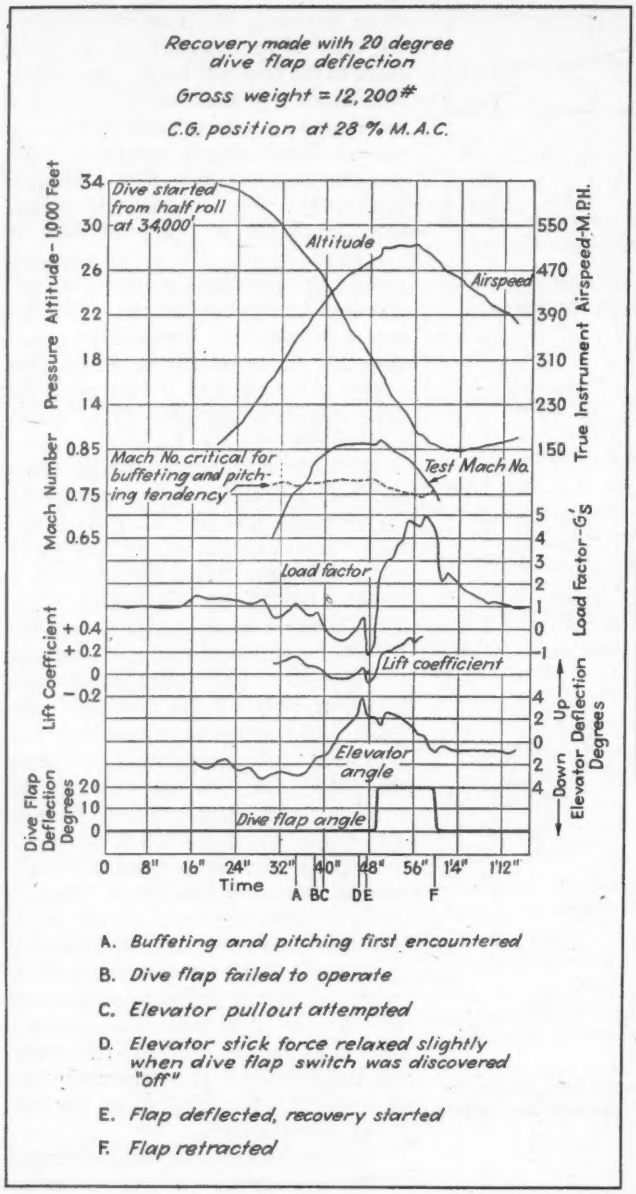

Recovery made with 20 degree dive flap deflection
Gross weight = 12,200#
C.G. position at 28 % M.A.C.
Pressure Altitude - 1,000 Feet
Dive started from half roll at 34,000'
Altitude
Airspeed
True Instrument Airspeed-M.P.H.
Mach Number
Mach No. critical for buffeting and pitching tendency
Test Mach No.
Load Factor-G's
Load factor
Lift Coefficient
Lift coefficient
Up — Down
Elevator Deflection Degrees
Elevator angle
Dive Flap Deflection Degrees
Dive flap angle
Time
A BC DE F
A. Buffeting and pitching first encountered
B. Dive flap failed to operate
C. Elevator pullout attempted
D. Elevator stick force relaxed slightly when dive flap switch was discovered "off"
E. Flap deflected, recovery started
F. Flap retracted

Fig. 10. Time history of .87 Mach number dive.

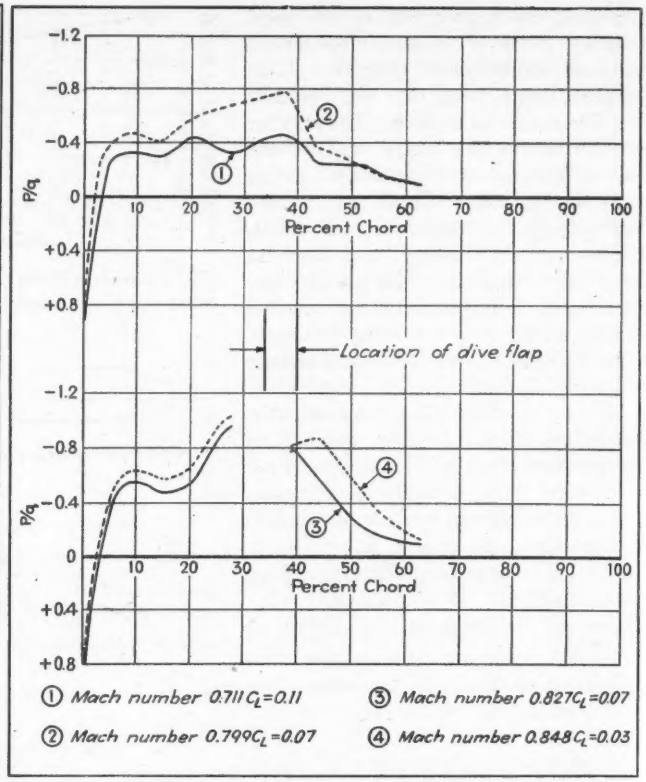


Fig. 11. Variation of pressure distribution over lower surface during .87 Mach number dive.

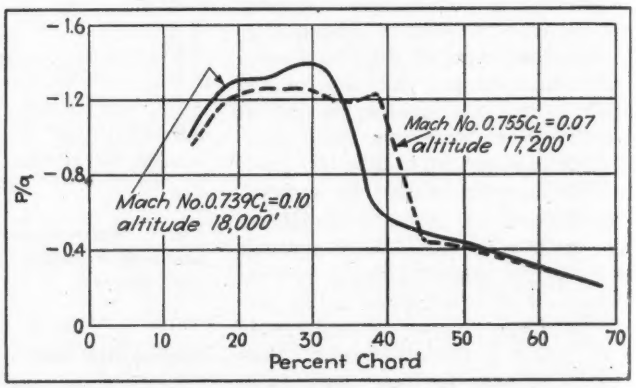


Fig. 12. Variation of pressure distribution over top of wing during dive in which buffeting and pitching tendency was momentarily encountered.

M = 0.90, respectively, and it means that with further increase in engine power, all types of conventional aircraft will tend to approach the same top speed—650 to 685 mph.

It is interesting that the same phenomenon is observed with ships, it being noteworthy how little the speed of express steamers has increased (*Mauretania*, built 1909, 70,000 hp.—24 knots; *Queen Mary*, 1938, 200,000 hp.—31 knots). For ships, also, there are limiting speeds above which the required power increases beyond all proportion. This critical point, at which the resistance rises abruptly, can be raised by increasing the length of the vessel. With aircraft, too, it would therefore be important to discover some means of postponing the occurrence of this critical point in the drag curve.

In designing high-speed airfoils:

(1) Move maximum thickness to 30-40 percent of the chord aft of the leading edge.

(2) Note that when the shock wave occurs, it tends to form opposite the maximum section.

(3) Consider that lenticular sections are best from the point of view of drag at very high speeds, but poor as maximum lift sections.

In the supersonic region, the airfoil experiences undulatory and frictional resistance. It can be shown that for almost rectilinear supersonic velocities, the body of least undulatory resistance, for a given volume, is bounded by two arcs of parabolas symmetrical with the X axis. Furthermore, for a body of minimum resistance, for a given volume, the frictional resistance, when considered, must equal the resistance due to the generation of waves.

Control Surface Design

Before discussing the action of the control surfaces, fuselage, wing, propeller, and engine cowl in high-speed dives, a few remarks will be made regarding the attainment of these dives.

The gross weight of the present-day fast airplane is such as to give wing-loadings of approximately 40-50 lb./sq.ft. This loading is quite high, and in a dive the weight of the plane acts as thrust. Coupled with large wing-loading and good aerodynamic cleanliness, modern high-speed planes

attain very high dive-speeds. It is inevitable that all planes will run into difficulty at speeds approaching that of sound.

Since the Republic P-47 attains a Mach number of 0.85 to 0.90 in dives, it is not surprising that difficulties have been encountered. It is unfortunate that Nature has decreed that the type of flow-pattern changes as we approach the speed of sound. With the establishment of the shock wave, the flow over the wing changes in such a manner as to induce a flow separation.

This results in material increase in the wing wake—of such a magnitude as to envelop the horizontal tail surface. By definition, the wing wake is a region of very turbulent airflow, and because of this turbulence the tail is subjected to buffeting.

We shall enumerate briefly the experiences encountered with the P-47 in high-speed dives and the steps taken in flight tests to overcome the difficulties:

(1) Elevators. During high-speed dives, compressibility has manifested itself through buffeting, increased stick forces, and a decrease in elevator efficiency. Special care should be exercised by the designer with regard to the slot and aerodynamic balance. The leading edge of the balance should not protrude beyond the normal contour of the stabilizer-elevator combination, for if it does, high local speeds will result, causing buffeting, experienced by the pilot as a slight shake of the control stick. From the high-speed aspect, it may be necessary that larger horizontal tail surfaces be used, or an adjustable stabilizer required. Internal sealed balances are highly recommended.

(2) Rudder. The observations applicable to the elevators also apply to the rudder.

(3) Ailerons. The Frise type aileron used on the P-47 has caused some difficulty at high speeds where the aileron's nose is deflected downward approximately 4 deg. (Fig. 7). At this point, the nose protrudes into the free stream and produces a flow breakdown causing the ailerons to buffet. The distribution of forces on the ailerons changes in character so suddenly and to such large degree that the pilot is unable to hold the control stick at a given point. The stick continues to move violently back and forth from one side of the plane to the other. This characteristic is referred to as "aileron snatch."

The original aileron (Frise type) installation had hinges flush with the lower surface. At speeds of 400 mph. and over, a violent oscillatory motion of the ailerons usually occurred. A series of flight tests were conducted to eliminate this condition, the procedure consisting of changing the position of the aileron hinge line.

Best results were obtained by moving the hinge line 1 in. down and 5/16 in. aft, with respect to the original position. The new arrangement did not completely solve the problem but limited the snatch condition to Mach numbers above 0.8. Further work led to the construction of a blunt nose aileron with a variable mechanical advantage in the control system to reduce stick forces. The blunt nose aileron with the differential control eliminates aileron snatch at high speeds up to 500 mph. and gives greater rolling velocities at all speeds.

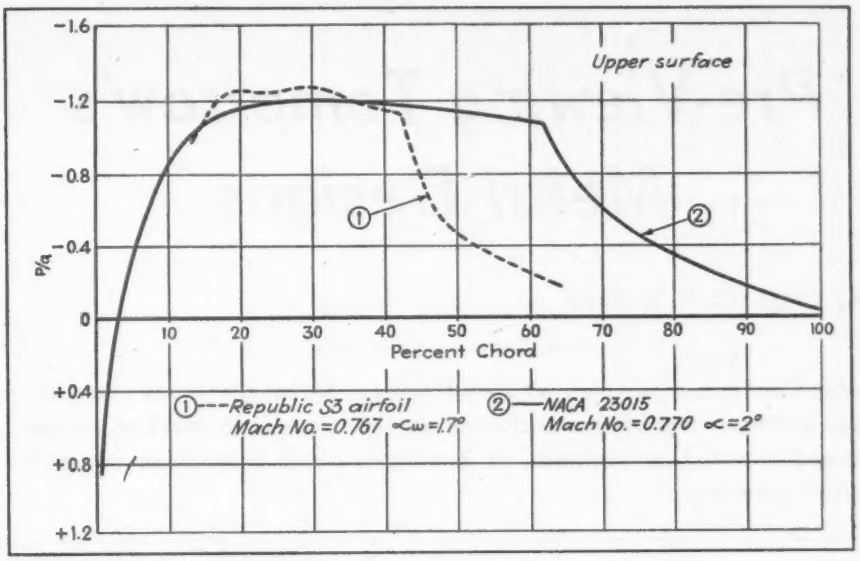


Fig. 13. Comparison of pressure distributions from wind tunnel and flight test at Mach number critical for buffeting and pitching tendency.

Fuselage

As a result of increased tail loads because of compressibility, the structural strength of the fuselage must necessarily increase. Tail loads are increased because of redistribution of forces on the wing, resulting in a dive tendency of the plane in general. Parts of the fuselage such as canopy, ducts, fillets, and doors must be reinforced because of increase in air loads resulting from high speeds.

Special emphasis has been given to the P-47 fuselage design with regard to the contours at the wing juncture in that the fuselage lines are substantially

(*Turn to page* 423)

Fig. 14. Sketch showing formation of shock wave in region of compression below curved plate airfoil at zero incidence in supersonic flow.

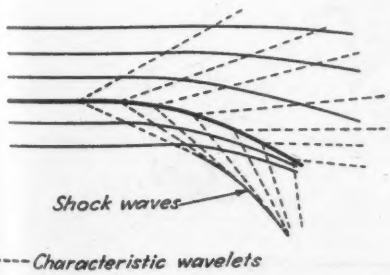
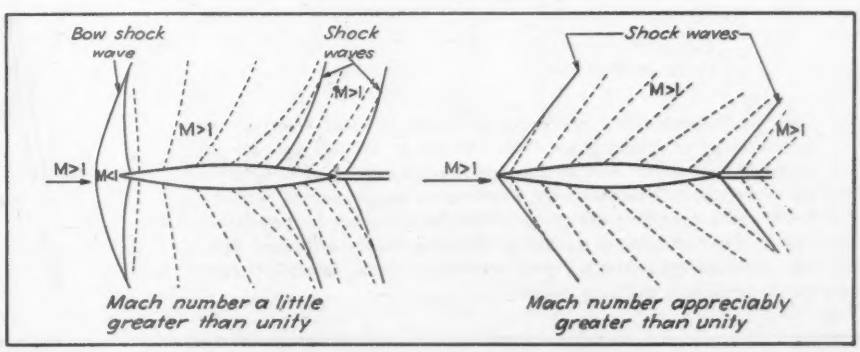


Fig. 15. Illustration of shock wave patterns for sharp-nosed airfoil as Mach number increases beyond unity.



Pre-Viewing Tomorrow's Metal Designs

By **CHESTER S. RICKER,** *Detroit Editor, "Aviation"*

With Illustrations by the Author

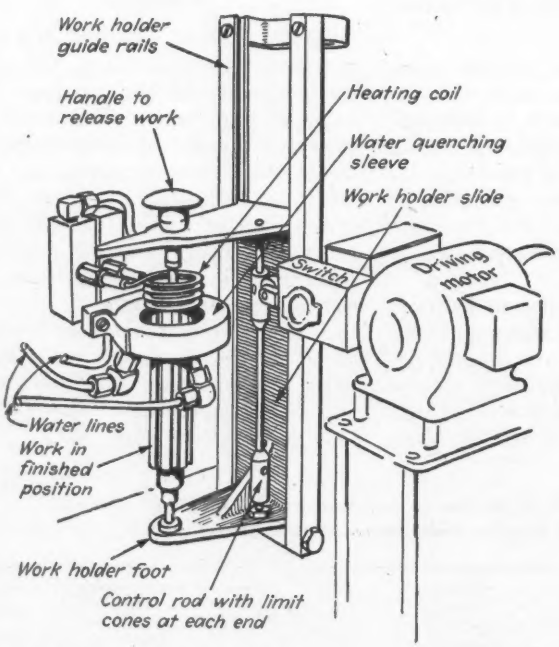
War Conference display at 26th National Metal Congress and concurrent meetings of five technical societies presage marked design changes and new methods of production and inspection for aircraft industry.

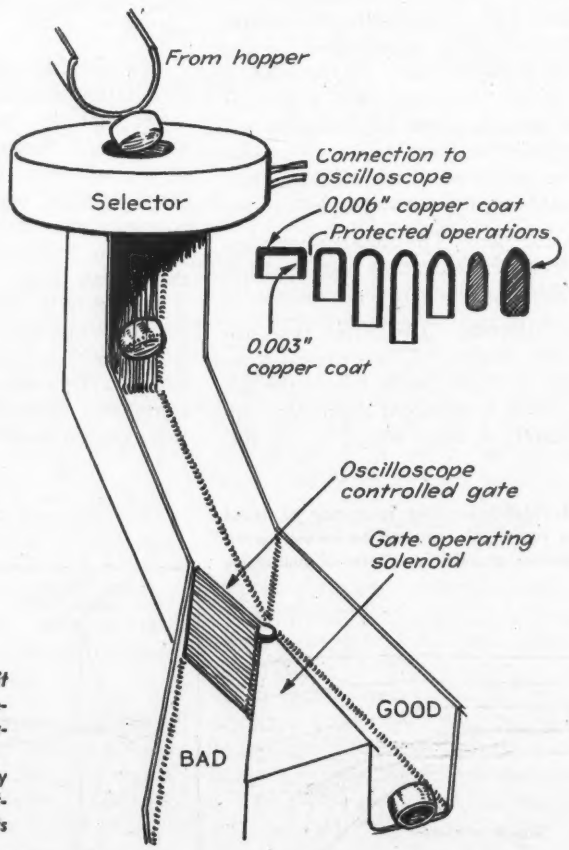
MORE THAN 160 PAPERS and 31 round-table discussions featured the 26th Annual Metal Congress in Cleveland, when the American Society for Metals, the Institute of Metals Div. of the American Institute of Mining & Metallurgical Engineers, the American Welding Society, the Society for Experimental Stress Analysis, and the American Industrial Radium and X-Ray Society held concurrent meetings.

Presentation at the ASM dinner of the Albert Sauveur Achievement Award to Walter Jominy, chief metallurgist, Dodge Chicago Div., Chrysler Corp., indicates the importance of his contribution to both steel makers and users. Every steel man queried reported that the setting of hardenability bands as determined by the end-quench hardenability tests bearing his name are going to take this test out of the laboratory onto the factory floor. It will help the steel maker dispose of slightly off-chemical analysis heats, make more steel available from various sources and thus speed production and assist procurement departments.

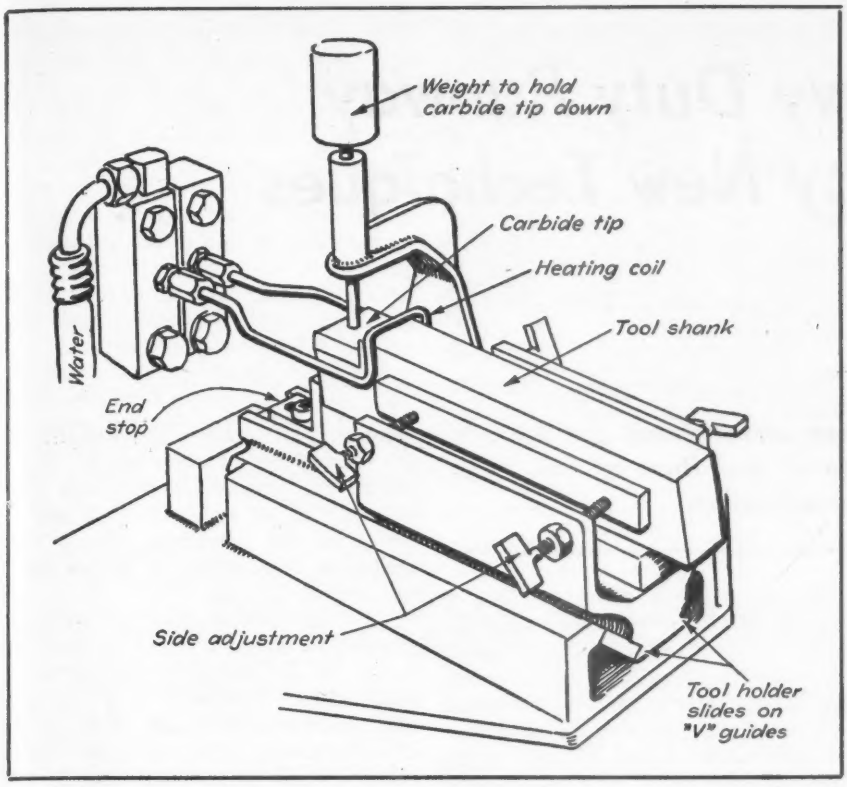
Outstanding features of the exhibits of more than 400 firms, plus the special papers, concerned induction heating; announcement of new aluminum and steel alloys, new developments in selection and inspection of materials, methods and dynamic results of shot peening, powdered metallurgy developments, and new welding techniques.

The American Welding Society held two sessions on aircraft welding at which the following papers were presented: *Impact Strength of Arc Welded Joints in Aircraft Steel* by H. O. Klinke, Republic Aviation Corp., *Helium Shielded Arc Welding of Exhaust Collector Rings* by F. H. Stevenson of Lockheed; *Multi-Arc Welding of Aluminum Alloys* by M. R. Rivenburgh and C. W. Steward of Curtiss-Wright; *Geometry of a Spot Welding Tip and Its Relation to Tip Life* by E. D. Crawford and C. W. Steward of Curtiss-Wright; *Survey of Chemical Cleaning Practices for Spot Welding Aluminum Alloys* by F. M. Morris, Kaiser Cargo Inc., Fleetwings Div., *An Evaluation of Process Control of Aircraft Welding* by P. H. Merriman





Left: On-the-spot sketch of Toccotron electronic heat treating unit demonstrated at Metal Show. From 350,000 to 600,000 cps. are required to heat spline shaft as it passes through heating coil. Continuous water spray quenches work immediately below heated section. Heating and quenching are so rapid that finished piece is immediately usable. Right: Electronic method of checking density of copper coating. Cathode ray-controlled gate separates rejects, catching defects not discernible to ordinary vision.

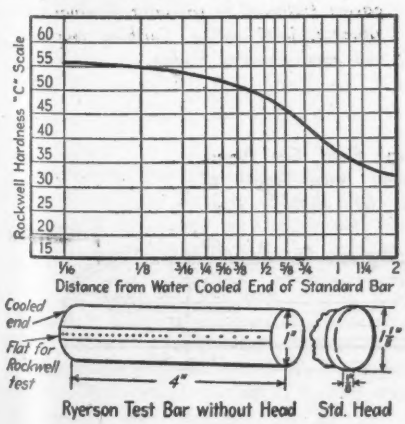


Latest electric heating unit developed by Ohio Crankshaft Co. has 7.5 kw. capacity at 9,600 cps. and is used for brazing carbide tips on tools.

of Glenn L. Martin; and *Characteristics of Welding Arcs on Aluminum in Atmospheres of Helium and Argon* by E. A. Wassel of General Electric.

New aluminum alloys presented at the congress were Aluminum Co. of America's 75-ST and Reynolds Metals' R-303. Alcoa's 75-ST has from 25 to 50 percent higher yield point than similarly treated Alclad 24-ST and 24-SRT. The company reported the new alloy is now available in extrusions and Alclad sheet and, in limited sizes, in tubing, bars, and plates.

Test sample and characteristic curve which can be plotted from it after making Rockwell hardness test. From this curve, hardness at any depth in similar steel can be estimated, as well as TS, YP, Elong. in 2-in., and percent Red. of area.



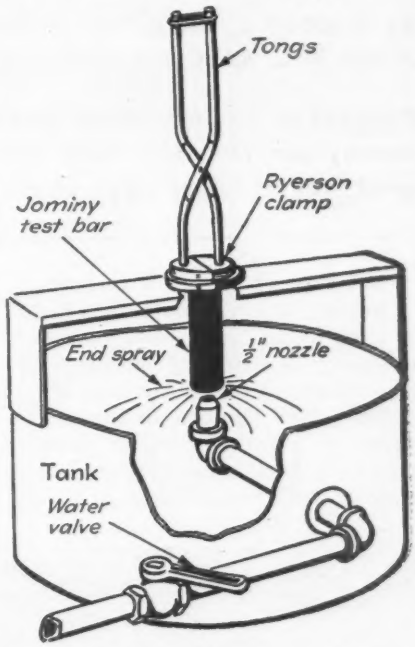
In the strength of materials round-table discussion, S. A. Gordon, chief test engineer of Glenn L. Martin, reported that in one case a 16-percent gross weight increase reduced takeoff speed by 6 percent; increased landing speed 8 percent; reduced range 17.5 percent; cut rate of climb 25 percent; and lowered top speed 6 percent. For greatest structural strength per pound, he advocated the shortest possible piece of material, deep rather than shallow beams, use of tension rather than compression members, combining two members wherever possible, elimination of all possible joints and splices, use of extrusions instead of forgings, and clevice bolts. On one airplane, he reported, 300 lb. had been saved through redesigning of fasteners. Additional weight savings can be made, he said, through use of heat treated glass in place of plate, and space fillers of wood or plastic.

At this same meeting, Horace C. Knerr, reporting on possibilities of steel in aircraft, gave the following comparisons of yield strength to specific gravity:

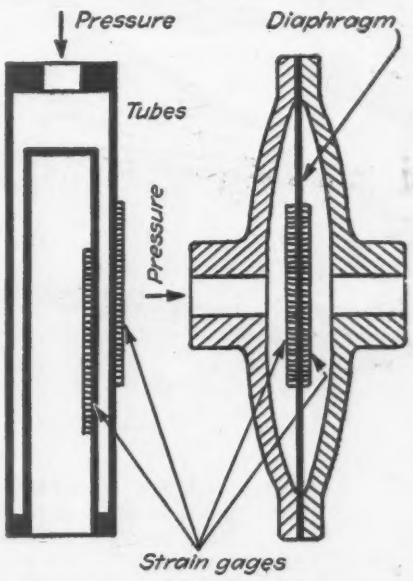
Music wire	400,000/7.8	51
Magnesium	35,000/1.8	19
Alum. alloy	52,000/2.8	19
Heat treated steel	150,000/7.8	19
Spruce	4,800/0.43	10
Oak	5,900/0.74	8
Steel	55,000/7.85	7
Cast aluminum	12,000/2.7	4.4

Savings of over $5,000,000 in labor costs through powdered metallurgy were reported by A. J. Langhammer, president Chrysler Corp's. Amplex Div., who said the process made possible production of vitally needed gear dies within a few weeks and the completed gears in 90 days. There were not enough machines in the country, he said, to turn out the required quantities by machining from the solid. In another case, hand wheels for guns

(*Turn to page 259*)



Jominy test unit as demonstrated by Jos. T. Ryerson & Sons. Note simple tongs which hold sample during test. This eliminates turning shoulder on piece and allows tests to be made with standard 1-in. bars.



Methods of using strain gages to record pressure, as exemplified in paper on "New Approaches to Engineering Design," by Stilson, Peterson, and Pocock of Bendix Aviation Corp. Strain gages on two tubes, one under tension, other under compression, are on opposite sides of diaphragm.

Heavy Duty Runway Built by New Techniques

By **RHODES E. RULE,** *Consulting Engineer, and*
JOHN F. L. BATE, *Project Construction Engineer*

Designed to take any weight plane now contemplated, new 8,500-ft. runway and taxi lanes built by Convair and Navy at San Diego point way to future large airport construction.

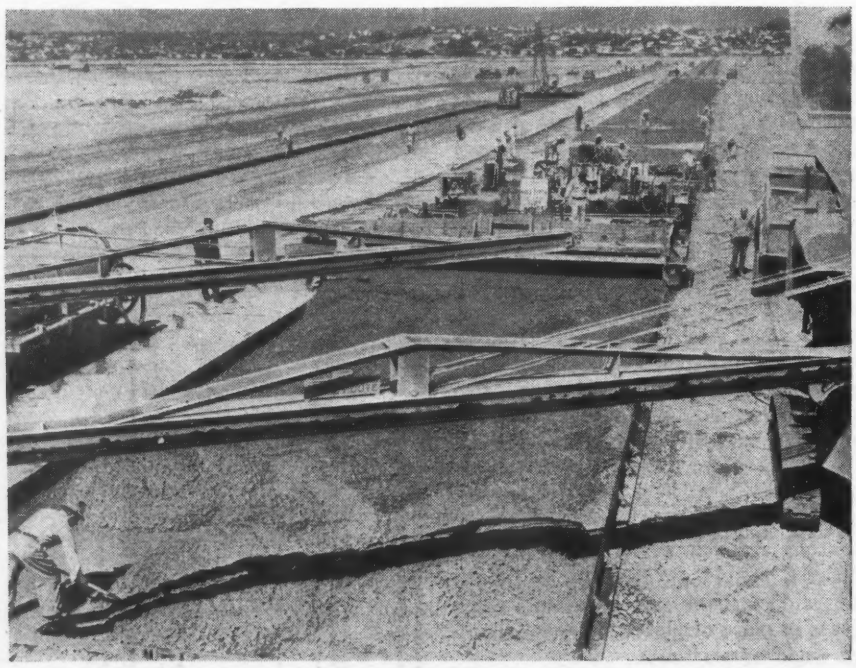
IMPROVEMENT OF THE MUNICIPALLY owned airport at Lindbergh Field, San Diego, Calif., as a joint war emergency undertaking financed by Consolidated Vultee Aircraft Corp. and the Navy Department Bureau of Aeronautics, will this month provide one of the finest prevailing-wind runways in the United States.

Construction has given the field a runway 200 ft. in width and 8,500 ft. long. It consists of a Portland cement concrete slab of uniform 12-in. thickness, except at the east end where a 14-in. thickness provides for additional vibration loads in the warm-up area. The taxi lanes are 75 ft. in width, and they are of the same thickness as the runway. These lanes are parallel to the runway for its entire length. Separating the runway and taxi lanes is a strip 225 ft. in width, divided into a series of flat catchment basins for temporary impounding of waters during extreme storms.

This intermediate paved area is constructed of asphaltic concrete from 3 to 5 in. thick. Similar paving has been specified for the shoulders, which are 50 ft. wide adjacent to the runway and 25 ft. wide next to the taxi lanes. This gives a total paved width of 575 ft. for the entire length of 8,500 ft.

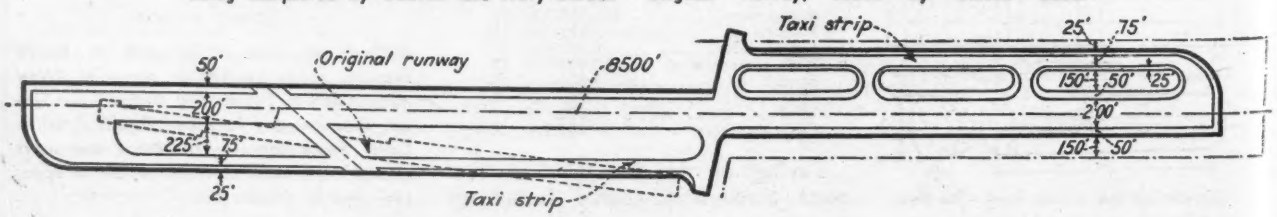
The new runway and the existing north-south runway are being completely lighted with the most modern ACN flush-type lights, and a complete system of obstacle lights is included at ends of both runways.

Construction of the runway provided many difficult problems in both engineering and construction. Because the field lies entirely on made land dredged from the adjacent bay bottom, careful consideration had to be given to the design of the foundations. A thorough sub-surface investigation preceded the design. Tests were made to determine the nature and supporting value of the various materials in place, and of the nearby deposits of sand and gravel available for making the necessary fill



Pouring concrete strip of 75-ft.-wide taxi strip parallel to new 8,500-ft. runway. In foreground are two 1½-cu. yd. capacity pavers, followed by spreader, internal slab vibrator, joint cutter, finishing machine, and hand finishing bridge.

Diagram of new 8,500-ft. runway, designed for planes weighing up to 170,000 lb. gross, just being completed by Convair and Navy Bureau of Aeronautics at Lindbergh Field, San Diego. New runway is more than twice length of original runway, shown by dotted lines.



and compacted sub-base, upon which the finishing paving rests.

Based on these investigations and conclusions, approximately 500,000 cu.yd. of unsuitable plastic material will have been removed upon completion of the work and replaced by selected materials of a demonstrated supporting value. The replacement materials include pit run gravel and sand used in the base of the fill, a selected sand base above the common fill, and crusher-run gravel which lies immediately below and forms the sub-base upon which the pavement rests. All of these materials are required to meet rigid physical acceptance tests to assure that their supporting value will equal or exceed the design computations.

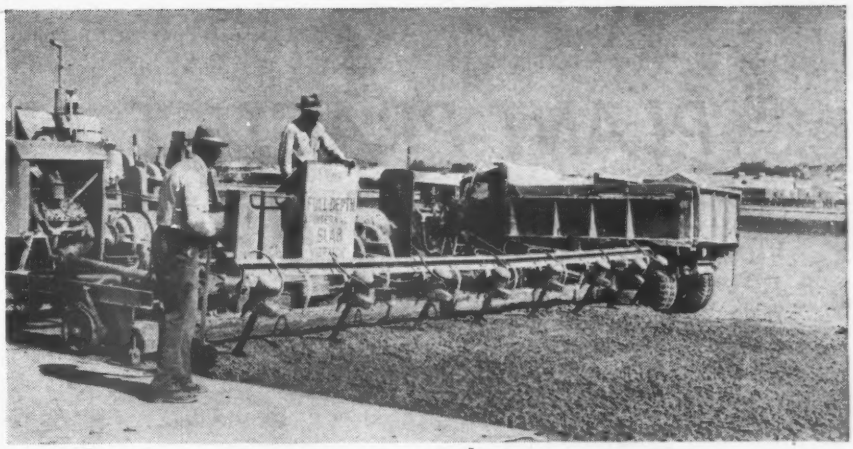
Design of the foundation and pavement assumed an 85,000-lb. wheel load. Results achieved during construction indicate that this may safely be increased to 175,000 lb. per wheel, which is ample for accommodating the heaviest types of airplanes now contemplated.

Great care and consideration were given to the preparation of the sub-base. At the west end of the project, which extended into unfilled tidal flats, a system of well points was installed and pumped until placement of that portion of the embankment had been completed in order to make certain of a preliminary settlement of the subsoils below the fill area. Settlement of 0.61 ft. maximum was recorded, with an average over the entire area of 0.21 ft. These de-watering operations provided a consolidation of the subsoils in this area, thereby making them equivalent in supporting value to the subsoils under the existing fill area of the tidal flats.

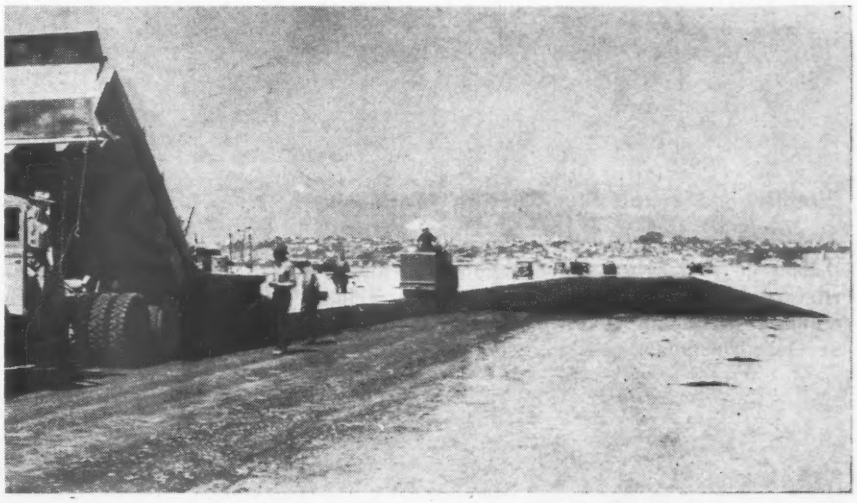
Earthwork is being accomplished by dragline excavation and truck haul to waste disposal areas and by carryalls where the excavated material is suitable for re-use in the embankment.

Imported borrow of selected material is hauled in by truck from two separate pits about 5 mi. from the field. This material is placed in 9-in. lifts, compacting to 6 in. Field density determinations are made frequently to check compaction, which was specified to be

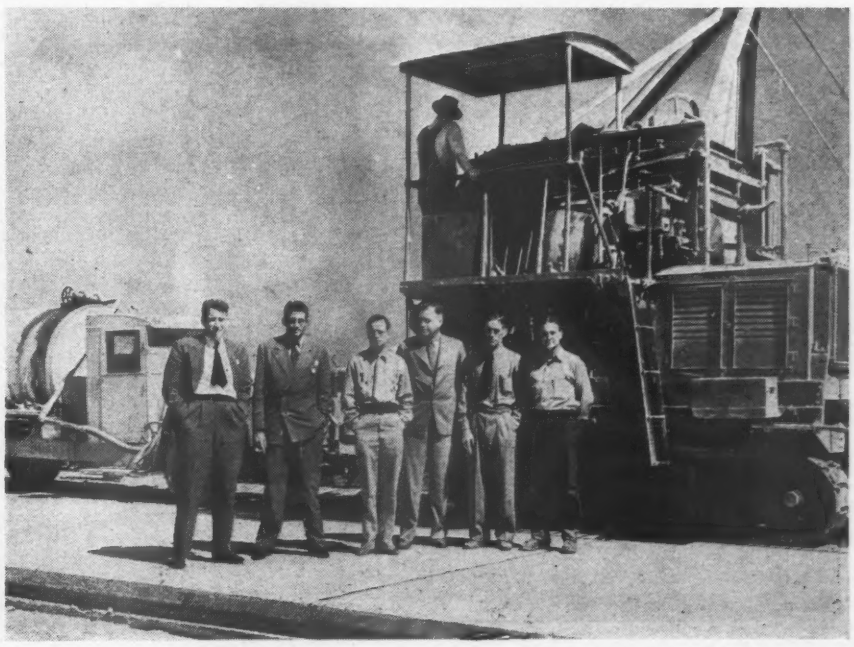
(*Turn to page* 260)



New Lindbergh Field runway is designed to handle planes of any weight now contemplated, and specifications—first such written—called for complete full depth internal vibration of concrete slabs. Electrically-operated elements, shown at work here, vibrate at 10,000 cpm.

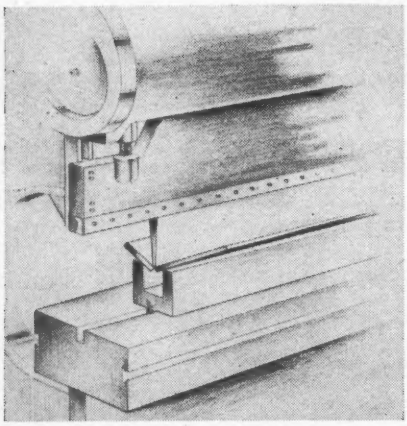


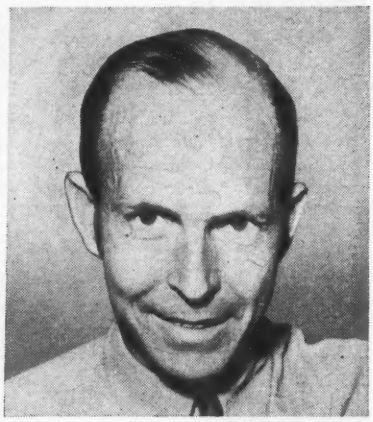
Shoulders, which are 50-ft. wide adjacent to runways and 25-ft. wide next to taxi lanes, are of asphalt-concrete material. Similar material, though of less thickness, is used in intermediate areas, giving total paved width of 575 ft. for entire runway length.



Here are men who directed job, which involved many problems due both to heavy weights of planes anticipated and fact that runway was constructed on made land. Left to right: Rhodes Rule, consulting engineer; J. F. L. Bate, Convair field engineer in charge of construction; Phil Helsey, Smith-Emery Testing Laboratories; L. G. Lynch, project manager; L. G. Krull, general superintendent; and R. L. Hapgood, concrete superintendent.

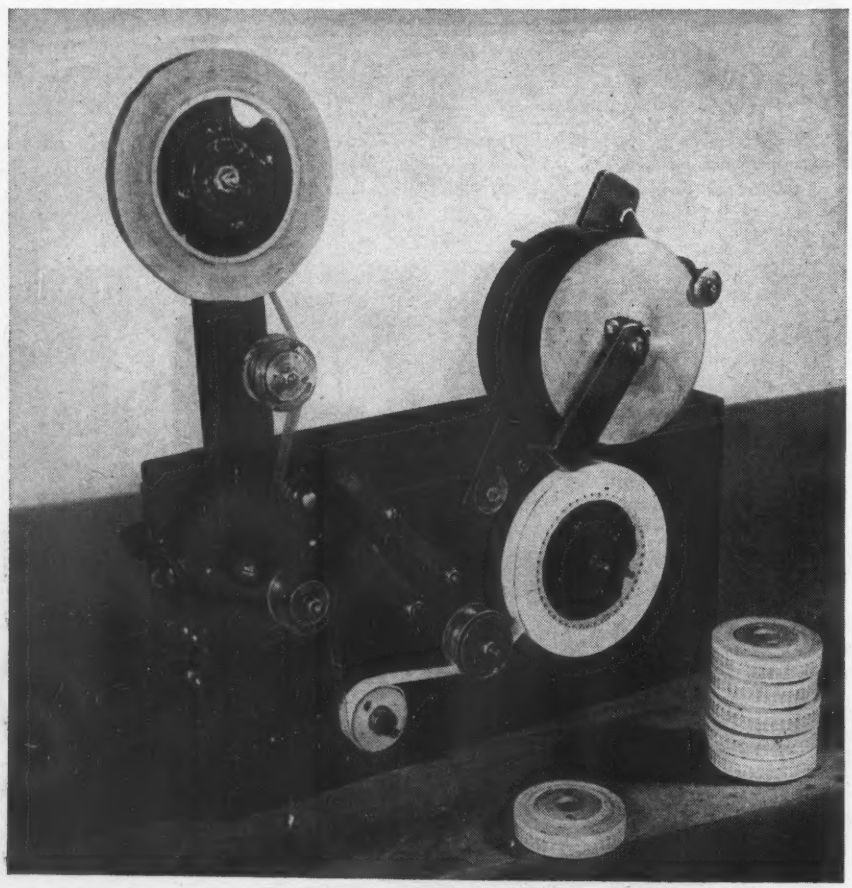
PLANT-PRACTICE HIGHLIGHTS





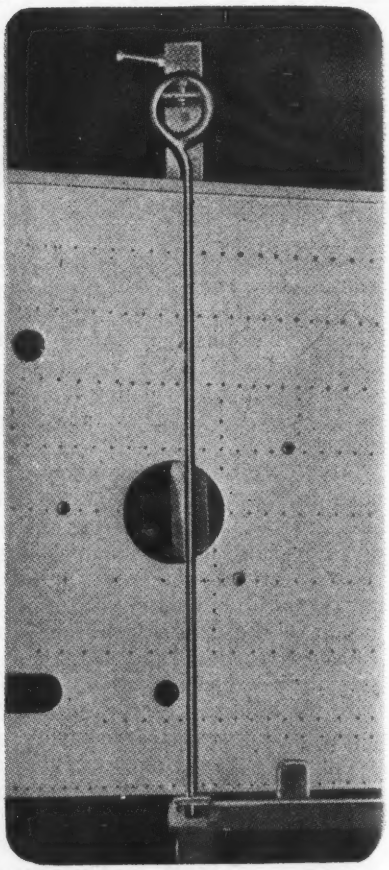
Simplified Method For Cutting Magnesium

• This idea for cutting magesium sheet calls for scribing to dimensions, then placing in power brake with scratch on lower side of sheet directly beneath edge of brake. Sheet breaks exactly on scribed line and very little filing is required to smooth it down. Pictured is Stanley Carrol, of Northrop, who developed method.



Skin-Hanging Device

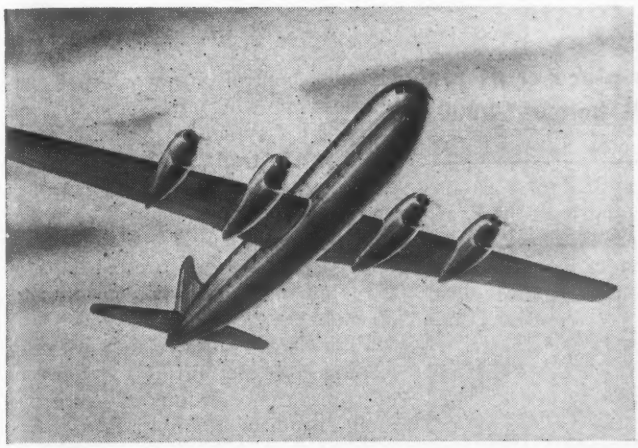
• Using round steel bars as hangers for sheet metal wing skin, Curtiss-Wright has provided an economical quickly-adjusted means for holding these odd shaped pieces while riveting them to frame of airplane. Inexpensive bars are rugged enough to stand considerable rough use before being scrapped.



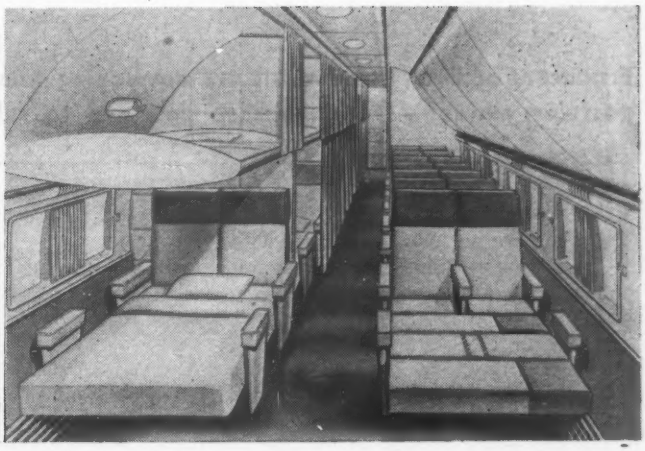
Identification Tape Made to Order

• Glenn L. Martin's electrical department uses this machine to print proper identification tapes for hundreds of wires used in large aircraft electrical and instrument systems. Machine, fitted with type on a roller, prints tape as required, thus eliminating necessity for carrying large stocks of material which might not always be what was required at the time. Through use of this machine, tape-shortage headaches have been eliminated, since any number or series of numbers may be turned out at short notice.

Boeing's Model 377 Stratocruiser



Artist's flight view of Boeing 377 Stratocruiser reveals ship to have similar silhouette to that of B-29 Superfortress. Airfoil is same—Boeing "117." However, Model 377 is 12 ft. longer and features two-deck inverted-figure-8 fuselage.



View of upper cabin interior shows how seats are made up into berths. At right, forward seat has been dropped in initial phase of change, while at left is seen completed lower berth with upper berth also dropped into place.

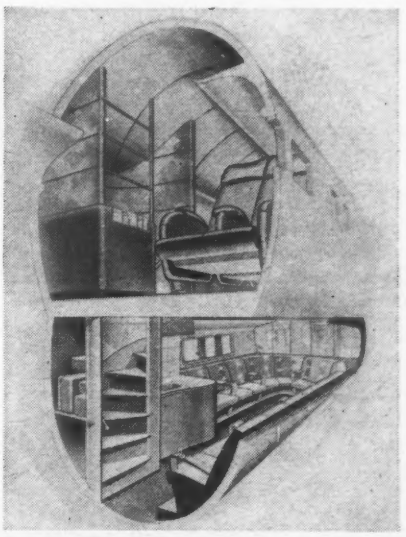
NEWEST OF BIG-TIME contenders aiming for the postwar air-traffic crown is the Model 377 Stratocruiser, announced by the Boeing Aircraft Co. as a four-engine low-wing two-deck pressurized-cabin passenger transport. Capacity of the plane is put at 72 to 100 passengers, while range is estimated at 3,500 mi., and cruising speed is specified as 340 mph., with a potential in top speed of 400 mph.

Stated to be an outgrowth of the company's noted B-29 Superfortress bomber, a prototype of the craft already has been completed and test flown in a military version which, when hostilities are ended, will translate into the postwar ship. All present models built will be employed in war service.

A day-transport version would afford the 100-passenger capacity by utilizing three cabins, while 72 would be carried by day in a sleeper version, or 36 with berth accommodations by night, with an additional capacity for 14 patrons in a lower-deck observation lounge.

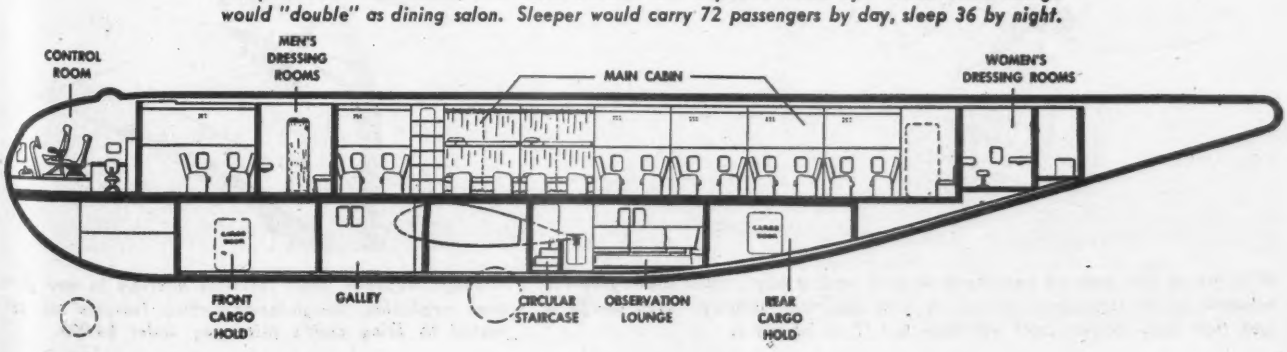
A third version of the craft would be an all-cargo transport carrying 35,000

(*Turn to page 272*)



This cutaway offers details of two-deck inverted-8 structure. Top portion shows seats which are convertible into berths, while below are appointments of combination observation, dining, and cocktail lounge, reached by circular stairway. All cabins are to be pressurized for comfortable over-weather flying.

Sectional drawing of luxury sleeper version indicates comprehensive accommodations planned for plane. In main cabin, two berth sections are depicted made up. Observation lounge would "double" as dining salon. Sleeper would carry 72 passengers by day, sleep 36 by night.



REPUBLIC PRESENTS PERSONAL AMPHIBIAN

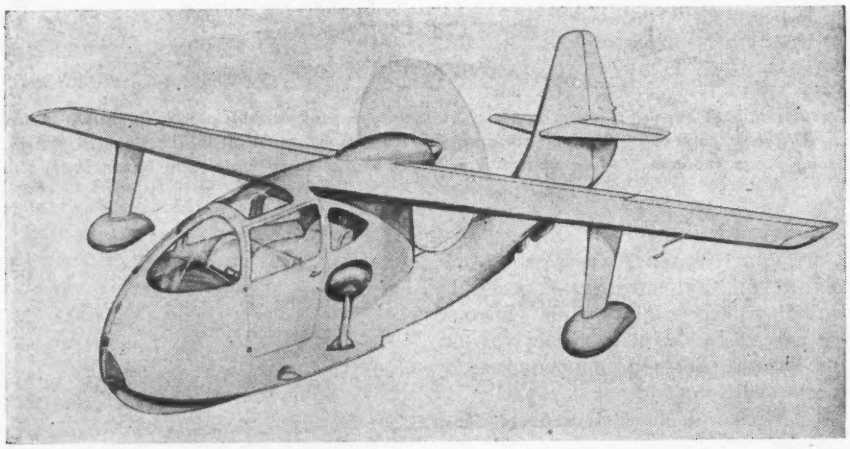
Producers of P-47 Thunderbolt are developing four-place craft for postwar market—175-hp. pusher designed to sell below $4,000.

REPUBLIC AVIATION CORP. is entering the personal plane field with a single-engine four-place amphibian now being developed from a prototype designed and built by P. H. Spencer.

In its present stage, the craft is a high wing metal monoplane with fabric covered control surfaces fitted with single-strut wing tip floats and embodying a 6-cyl.-opposed pusher engine fitted in the trailing edge of the wing at the top of the cabin. Empennage and tail wheel are mounted on a slender fuselage running aft of the cabin under the propeller. Slotted flaps will give landing speed of approximately 50 mph.

Pilot's seat is located forward of the leading edge, permitting extensive use of transparent sections to give maximum visibility. Cabin is slated to have luxurious appointments.

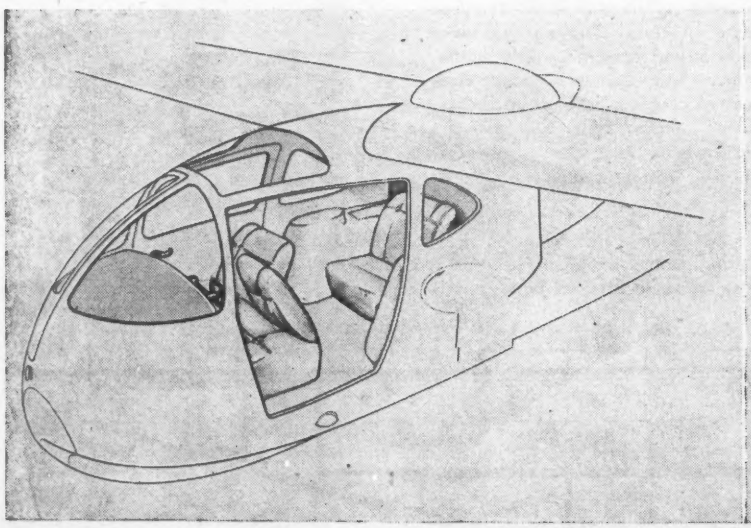
Although the list price has not yet been finally determined, Republic officials state that this Thunderbolt amphibian will probably sell for less than $4,000.



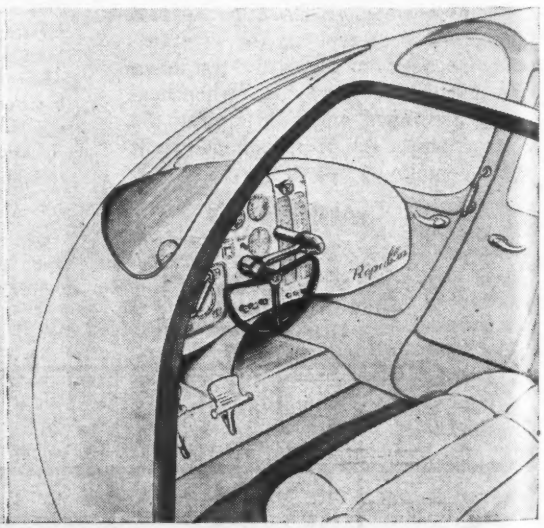
Artist's conception of Thunderbolt amphibian being developed by Republic Aviation Corp. for postwar personal plane market. Powered with 175-hp. 6 cyl. horizontally opposed engine, craft is designed to have top speed of 120 mph., cruising speed of 105, and landing speed of approximately 50 mph.

Preliminary Specifications and Data

Span	36 ft.
Length	26 ft. 6 in.
Height (on wheels)	8 ft. 7 in.
Water draft (fully loaded)	17 in.
Gross wt.	2,600 lb.
Max. speed	120 mph.
Cruising speed	105 mph.
Landing speed (approx.)	50 mph.
Cruising range	over 500 mi.
Power (tentative)	175 hp.



With two of four seats set well ahead of wing leading edge, cabin is designed for extensive use of transparent sections to give maximum visibility. Hull design is such that, fully loaded, craft will draw but 17 in. of water.



Although Republic plans luxurious interiors in new personal amphibian, design-for-production features are expected to bring craft's price tag under $4,000.

Handley Page Bid For Transport Market

Four-engine Hermes transport carrying up to 50 day passengers, or, in cargo version, up to 16,000 lb., nears flight tests.

AN ADDITIONAL BRITISH CONTENDER in the postwar transport plane field is the Handley Page Hermes, on which some details have just been released, and the prototype of which will soon reach flight-test stage.

An all metal, stressed skin, low-wing, four-engine monoplane bearing a great profile resemblance to the Douglas C-54, the Hermes will be built in two versions: As a passenger liner carrying up to 50 passengers on short flights; and as a cargo transport carrying up to 16,000 lb. on a 70,000-lb. gross weight basis.

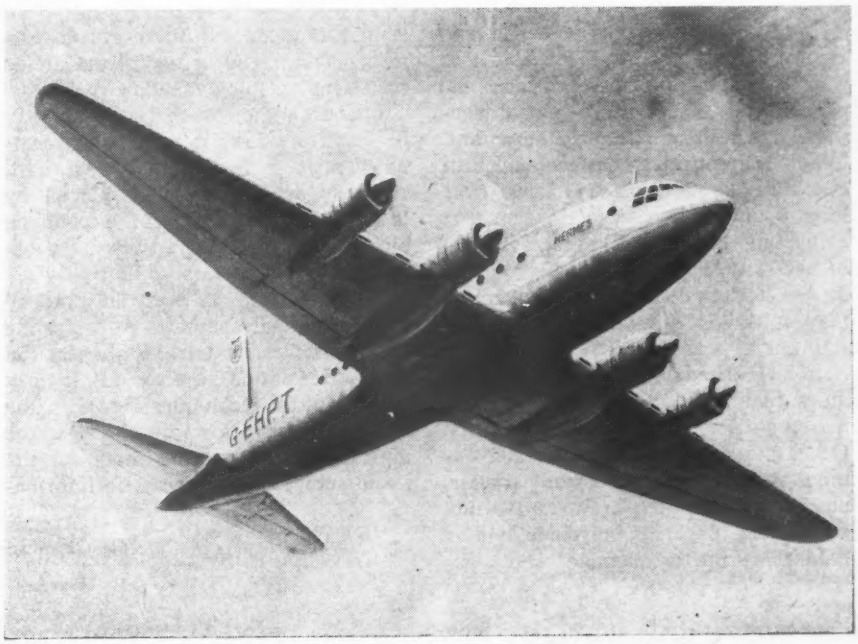
In the passenger version, provision will be made for cabin pressurization to permit flights up to 25,000 ft. altitude. Alternate passenger layouts are being designed for varying routes. One version calls for seating of 34 passengers for day travel, and another de luxe version featuring a club saloon, would seat 20, while for shorter trips, provision could be made for 50 passengers. Still another version provides accommodations for 32 passengers by day, with seats convertible into berths for 16 passengers.

All versions call for a crew of six, comprised of two pilots, a flight engineer, a radio operator, an avigator and one or more stewards.

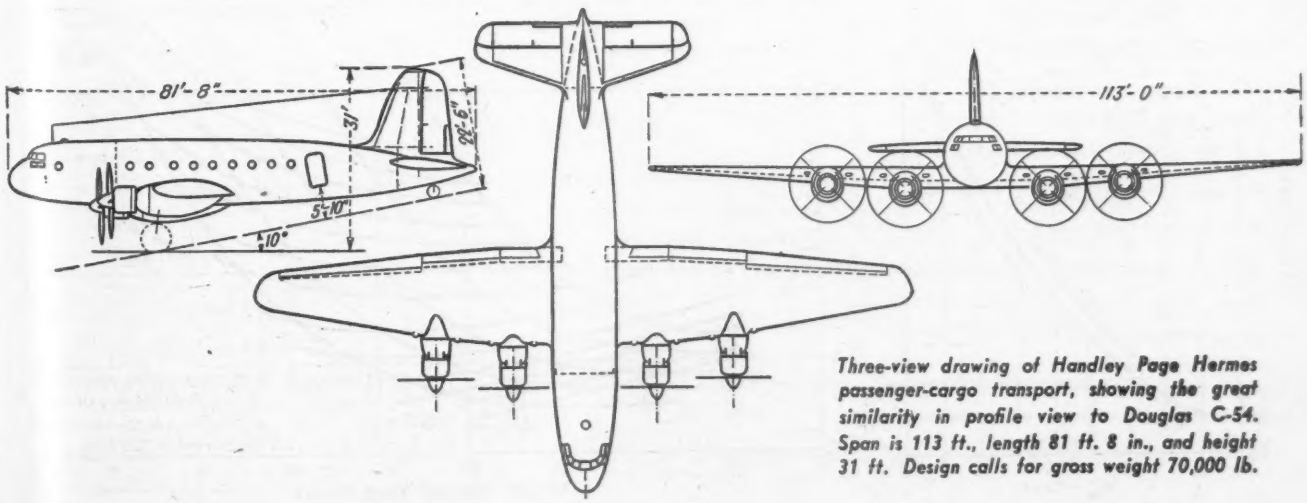
(*Turn to page* 265)

Specifications and Performance Data

Span	113 ft.
Length	81 ft. 8 in.
Height	31 ft.
Gross wt	70,000 lb.
Capacity	
Passengers, day	Up to 50
Passengers, night	16
Cargo	16,000 lb.
Maximum speed	340 mph.
Maximum cruising speed	289 mph.
Economical cruising speed	240 mph.
Fuel capacity	2,750 Br. gal.
Maximum range	2,000 mi.
Power plant	four 14-cyl. 1,600-hp. Bristol Hercules



Artist's conception of Handley Page Hermes four-engine transport, prototype of which is scheduled for initial flights in near future. Powered by four 1,600-hp. Bristol Hercules sleeve-valve engines, Hermes is designed for top speed of 340 mph. and minimum range of 2,000 mi. (Samson Clark photos)



Three-view drawing of Handley Page Hermes passenger-cargo transport, showing the great similarity in profile view to Douglas C-54. Span is 113 ft., length 81 ft. 8 in., and height 31 ft. Design calls for gross weight 70,000 lb.

Discussing the information required for determining range and cost estimates, and citing the need for basic test-flight figures and derivative charts, the author declares that makers of transport craft should —

GIVE OPERATORS MORE CRUISE-CONTROL DATA

By **JAMES B. REA,** *Engineering Test Pilot, Consolidated Vultee Aircraft Corp.*

WITH THE ADVENT of larger and larger aircraft, the problem of establishing an accurate and economically sound cruise-control technique has become extremely important. When one considers the economics of operating large transport planes over long distances, it becomes evident that competing commercial operators will, of necessity, have to be well-grounded in the technique of cruise-control if they intend to stay in business after the war.

It is realized by most airline operators that fuel cost alone is not the major portion of total operating costs. Other costs such as airplane and engine depreciation, overhaul, repair, and ground service; crew pay, insurance, and expense; airplane public liability, property damage, and accident insurance; and interest on investment, etc., are but a few of the major costs tending to overshadow fuel costs.

But even though cost of fuel may be relatively low, it must be remembered that it is the equivalent cost, resulting from payload displaced by fuel, which greatly affects the economic picture when considered from the aspect of dollars per ton-mile.

In the past it has been the practice for commercial operators to determine for themselves, by actual flight test, the basic information required to set up a cruise-control technique. But with the growth of large aircraft, the operator must depend more and more on the manufacturer to supply basic information. The operator has neither the time, the test equipment, nor the engineering flight-test personnel required for such extensive and costly tests. For this reason, most of the aircraft manufacturers have become cruise-control conscious, especially from the flight-test point of view.

Individual operators have their own particular techniques for cruise-control. Some prefer to fly at constant indicated airspeed, some at constant brake-horsepower, some at maximum-range speeds, and others at airspeeds of constant amount, or percent, higher than maximum-range speeds.

It is normally not the policy of the manufacturer to recommend that the operator use any particular method of cruise-control, but it is essential that he supply the operator with basic

Fig. 1. Speed-power chart, based on "iw" parameters.

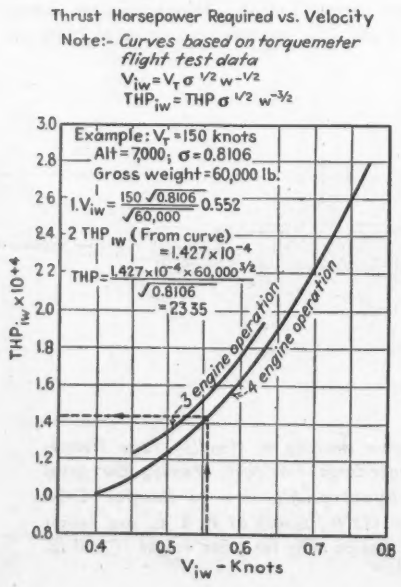
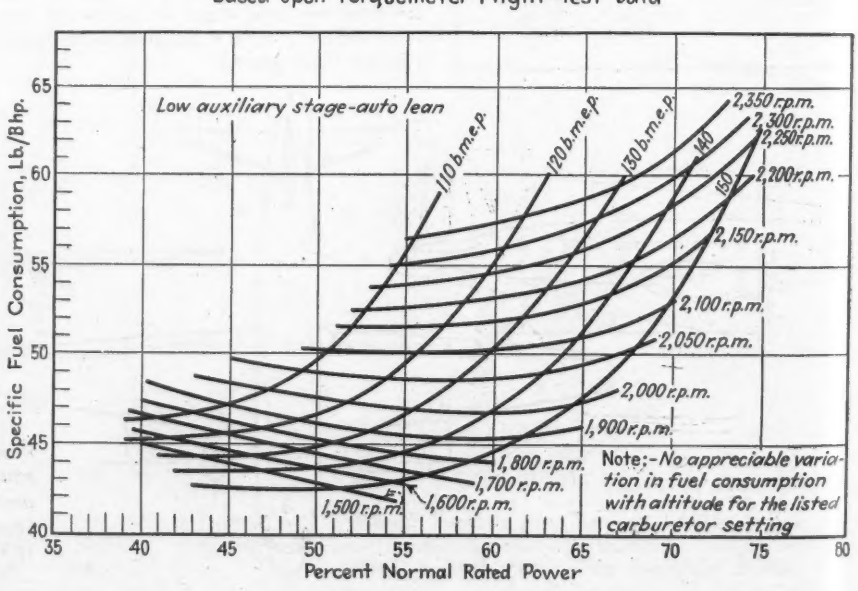

Thrust Horsepower Required vs. Velocity
Note:- Curves based on torquemeter flight test data
$V_{iw} = V_T \sigma^{1/2} w^{-1/2}$
$THP_{iw} = THP\, \sigma^{1/2} w^{-3/2}$
Example: V_T = 150 knots
Alt = 7,000; σ = 0.8106
Gross weight = 60,000 lb.
1. $V_{iw} = \frac{150\sqrt{0.8106}}{\sqrt{60,000}} = 0.552$
2. THP_{iw} (From curve) $= 1.427 \times 10^{-4}$
$THP = \frac{1.427\times10^{-4}\times60,000^{3/2}}{\sqrt{0.8106}} = 2335$
3 engine operation
4 engine operation
$THP_{iw} \times 10^{+4}$
V_{iw} - Knots

Fig. 2a. Master fuel-flow chart.



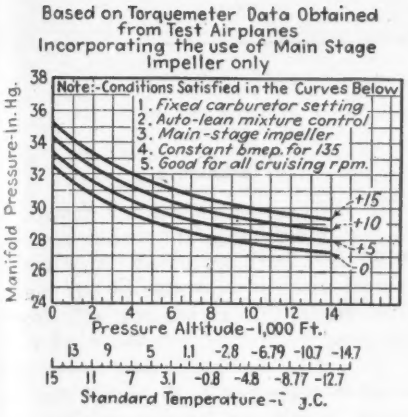

Based on Torquemeter Data Obtained from Test Airplanes Incorporating the use of Main Stage Impeller only
Note:-Conditions Satisfied in the Curves Below
1. Fixed carburetor setting
2. Auto-lean mixture control
3. Main-stage impeller
4. Constant bmep. for 135
5. Good for all cruising rpm.
+15
+10
+5
0
Manifold Pressure-In. Hg.
Pressure Altitude-1,000 Ft.
Standard Temperature-°C.

Fig. 2b. Typical manifold pressure—pressure altitude chart for constant bmep.

flight-test data and derivative cruise-control charts, so that the relative economies of the various techniques may be judged.

The Air Transport Association has recently established a standard form to be used by all manufacturers when presenting basic operations and cruise-control information to commercial airlines. It is hoped that in the future all manufacturers will follow this form.

The basic engineering data required for determining range and cost information for various cruise-control techniques are:

1. Speed-power characteristics.
2. Engine characteristics.
   a. Fuel consumption information.
   b. Manifold pressure—pressure altitude calibration for constant *bmep*.
3. Propeller characteristics.

Fig. 1 shows a speed-power chart based upon *"iw"* parameters. This method of showing speed-power allows one curve to represent the speed-power data for all operational gross weights and altitudes.

Fig. 2a shows a master fuel-flow chart. This type of chart has an ad-

(*Turn to page* 298)

Symbols Used

ρ	— Density altitude.
ρ_o	— Standard density altitude at sea-level.
σ	— ρ/ρ_o.
L	— Lift.
C_L	— Lift coefficient.
D	— Drag.
D	— Propeller diameter.
V	— True airspeed.
V_{iw}	— $V \times \sigma^{1/2} \times W^{-1/2}$.
W	— Gross weight.
$thp.$	— Thrust horsepower.
$thp._{iw}$	— $thp \times \sigma^{1/2} W^{-3/2}$.
$bmep.$	— Brake mean effective pressure.
N	— Propeller *rpm.*
$rpm.$	— Engine *rpm.*
c	— *s. f. c.* = specific fuel consumption.
η	— Propeller efficiency.
J	— V/ND.
C_p	— Propeller power coeff. $= \frac{5 \times 10^{10} \times bhp. \times P}{\sigma \times N^3 D^5}$
P_f	— Propeller power factor.
iw	— Parameter subscript.

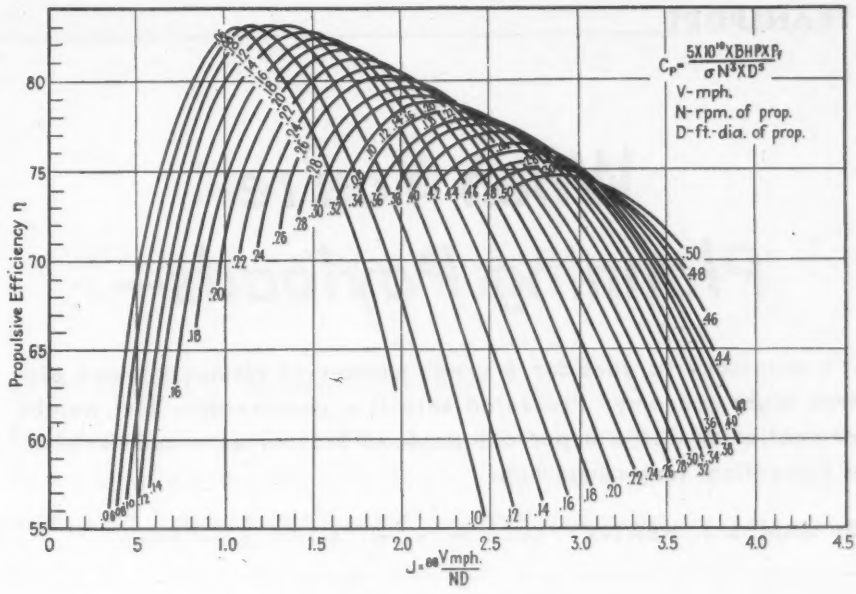
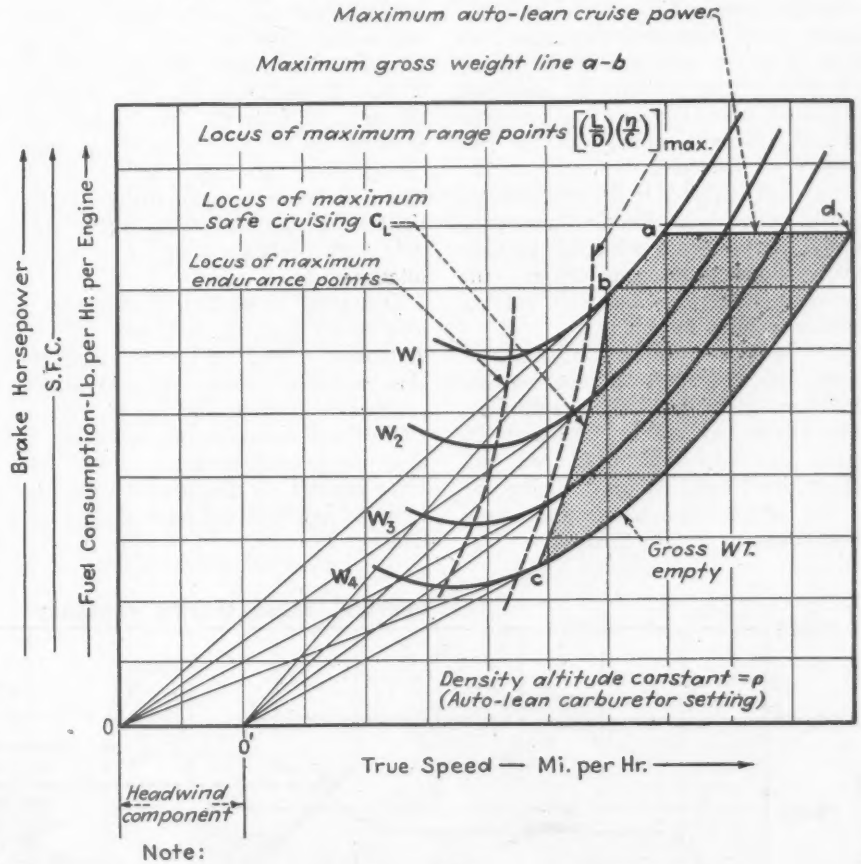

Propulsive Efficiency η
$C_p = \frac{5 \times 10^{10} \times BHP \times P_f}{\sigma N^3 \times D^5}$
V-mph.
N-rpm. of prop.
D-ft.-dia. of prop.
$J = \frac{88 V mph.}{ND}$

Fig. 3. Propeller efficiency chart.

Fig. 4. Curves of fuel-flow, in lb./hr./engine vs. true speed.



Note:

1. *All points computed for* $\left(\frac{\eta}{c}\right)$ *max. with BMEP max. limitation due to engine wear considerations.*
2. *Horizontal lines represent constant BHP operation.*
3. *Vertical lines represent constant speed operation.*
4. *Tangent lines from origin determine maximum range points.*
5. *Shaded quadrilateral a-b-c-d represents auto-lean operations range.*

When You're Planning Payloads—

it's necessary to consider a great number of elements which disturb flight economy. Presented here is a conservative fuel-weight evaluation of these important payload factors as encountered in a theoretical long-range hop.

By **JAMES J. HEATLEY,** *Operations Engineer, American Export Airlines*

IN FORECASTING the results of any newly proposed airline operation, a trial balance must be set up for anticipated costs and revenues. In developing these expected revenues, we have, first, our estimated traffic potential which, with the type of operation proposed, should determine the type of aircraft most suited and the frequency of schedules.

Payload available is the fundamental consideration in beginning the revenue study. It will vary with the distance to be flown, the route chosen, the season of the year and, last but not least, the pilot technique.

Let us conservatively evaluate these items on a theoretical approximate 3,000-mi. flight and see, quantitively, how much they cost in payload. To make this trip interesting, we will select the North Atlantic during the winter and a Great Circle track from New York to Southampton.

The accompanying chart illustrates a vertical cross-section of weather conditions en route. The dash line indicates the path of the plane initially cleared at 8,000 ft., with light icing forecast at the higher altitudes and the 0 deg. C. isotherm low and passing through cloud layers. The captain has selected the higher altitude as most conducive to safe flight, on the theory that it is better to have altitude under light icing conditions than a low altitude with probable icing of unknown intensity.

Operating over such a distance, a long-range cruising technique will be employed. This offers a relatively slow airspeed and an angle of attack somewhat short of that for maximum *L/D*. Fundamentally, this technique is designed around airspeed as the primary control, so that shall be the one variable to which we must closely adhere.

Turbulence

In 3,000 mi. we may expect approximately 5 hr. moderate turbulence at 8,000 ft. Turbulence will vary with frontal activity. Because of our high trim angle, this turbulence will drop us about 8 knots in airspeed for 5 hr.

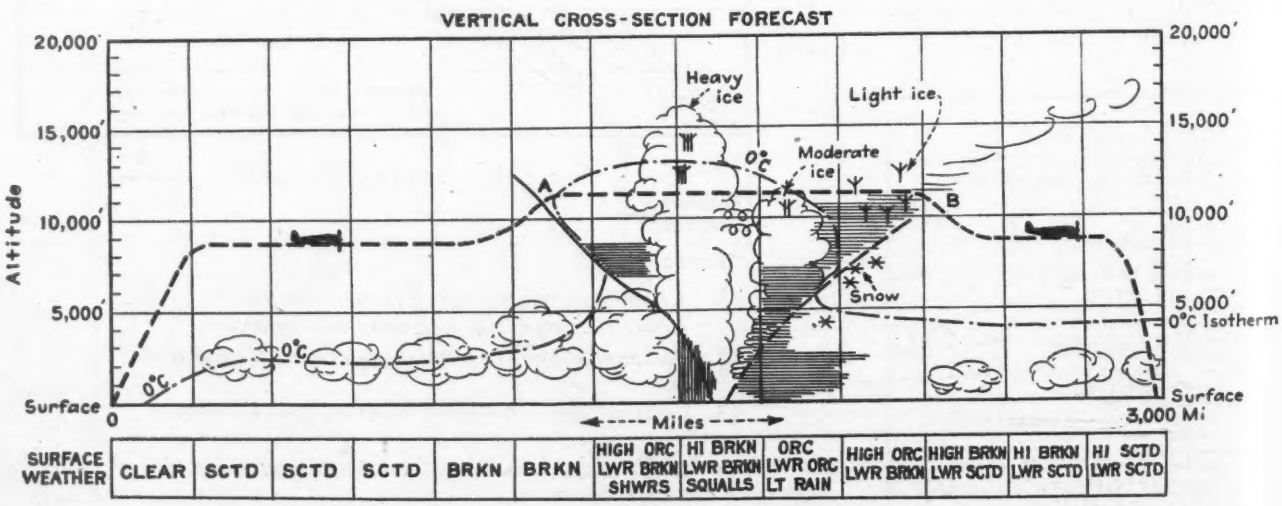
To retain our prescribed speed we must increase power to regain that 8 knots—increase it by some 60 hp. on the basis of airspeed varying as the cube of the hp. At .43 specific fuel consumption, we lose 129 lb. of fuel to this turbulence.

Intentional Deviations From Track

In a long-range flight, circumstances will normally arise that will require a deviation from the prescribed track as planned. A thunderhead or large cumulus might lie directly in the path of flight. Perhaps the avigator may require double drifts or may wish to change course to check compass heading deviation. Nowadays, moreover, convoys must be skirted and enemy aircraft and surface craft avoided on ocean flights. Eliminating wartime circumstances, an allowance of at least 30 extra miles should be expected for these intentional deviations.

The flight path through the frontal activity pictured in the chart may be considered as an example. Between (A) and (B), the cross-section portrays a considerable amount of high cumulus cloud. Rather than being solid, as may be interpreted by those unfamiliar with the cross-section type of chart, these clouds are usually

(*Turn to page 297*)



Typical cross-section of weather encountered in 3,000-mi. transocean flight. Captain of plane must continually evaluate disturbing factors of avigational facilities, turbulence, rain, and icing in relation to "miles made good" and "remaining fuel".

Aircraft Stocks Climb Out of Bear Pit

By **RAYMOND L. HOADLEY,** *Financial Editor, "Aviation"*

Airline orders, coupled with confidence in postwar designs shown by personal plane producers, finally give Wall Street the belief—along with industry itself—that aviation is here to stay.

THE FOUR-YEAR BEAR MARKET in aircraft stocks is over. Even Wall Street begins to feel that here is an industry with peacetime growth prospects—a possibility that was somehow overlooked when prices of leading stocks were carried down to only 40 percent of their previous highs.

What are the reasons for this sudden about face? In the first place, Wall Street began to prick up its ears when three airlines ordered $50,000,000 worth of transports on a when-as basis. These orders have continued to trickle in until the commercial transport backlog of three companies—Douglas, Lockheed, and Curtiss-Wright—total more than $230,000,000.

This advance backlog of unfilled orders is larger than the entire industry's sales of $225,000,000 in 1939; the year the British, French, and Dutch were taking delivery on all the American planes they could find.

Besides the more than 200 transports on order or under negotiation, another 100 transports were under active consideration when this was written. That, of course, does not count the potential orders for the monster transports now on the drawing boards that won't be in profitable production until 1948 or so.

Then there is the foreign market. It will be years before any other nation in the world can produce transports at home. Already foreign airline officials are vieing with each other to "line up" American planes for use on the world's airways as soon as they can be opened for peacetime traffic.

Thus there is little wonder that Wall Street recently purchased aircraft stocks in such volume that prices rose nearly 50 percent from their 1943 lows. But there are other reasons why the bear market is over. For one thing there is scarcely any talk these days about the continued solvency of the industry after the war.

The industry admittedly put its worst foot forward in order to get Congressional action on the huge problems involved in shrinking the nation's largest wartime industry back to its normal size. The problems have been faced by a sympathetic Congress and by military officials dealing with reconversion, so there is now less tension on that score. Granted, there still are plenty of problems ahead, but the public hears less about them.

As just one example of how the reconversion picture has changed for the better in the last few months, the government will permit plane makers to sell company-owned materials to the United States for $1 and use the inventory loss for tax purposes. Then, too, the industry really benefits from the so-called relief provisions in the present tax law. The industry can obtain a tax refund by charging any reconversion losses against two years of wartime earnings.

Turning now to current operations, it appears that 1944 earnings will, on the average, be fairly close to the satisfactory showing made throughout the industry last year. True, results may be a bit more spotty, but the fact is that cutbacks in production have not come through in sufficient volume to have the reverse effect feared early in the summer.

Meanwhile, the plane makers are getting their houses in order at a faster clip than was thought possible a year ago. The 1943 results, as shown on the balance sheets, marked a decided improvement over the strained position many companies revealed at the end of 1942. This year, further long strides will be made towards a highly satisfactory financial position.

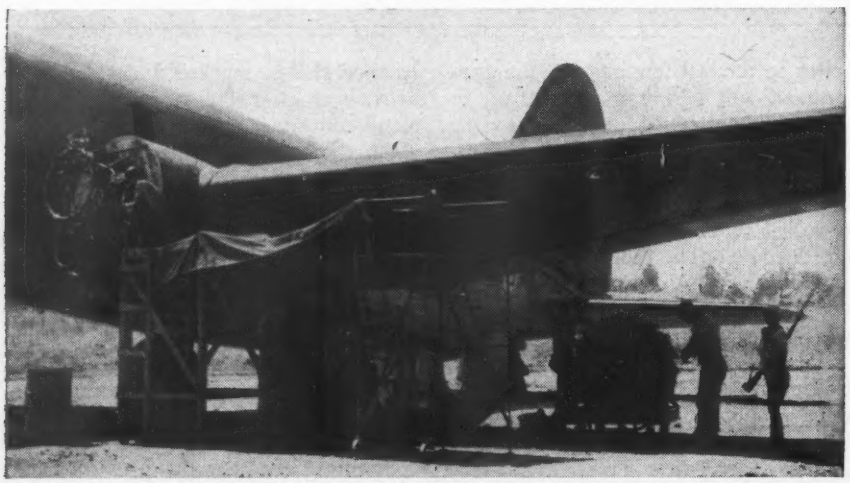
For example, Consolidated Vultee is reported in well informed circles to have added about $10 a share to its total net resources in the last twelve months, bringing that figure to around $33 a share. Douglas Aircraft is believed to have around $80 a share in net current assets, against about $60 a share a year ago.

Pointing out that the present price level for aircraft stocks was a realistic one, a prominent brokerage firm recently noted that leading stocks were selling at only slightly more than their

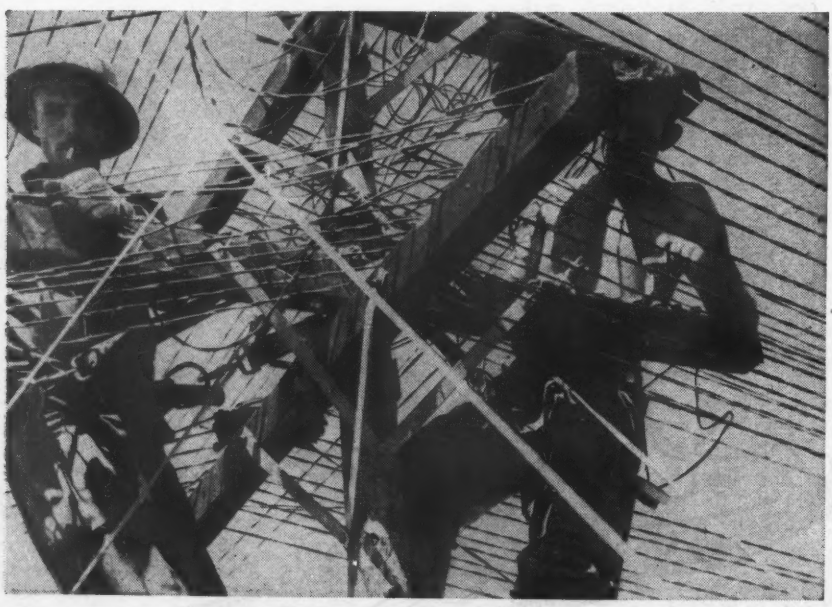
(*Turn to page 262*)

REPAIRING 'ROUND THE WORLD

Mobile self-contained ATSC Service Group works way to China through nine countries, keeping everything from fighters to cargo planes fit enroute.



India was just a stop-over for "mechanicommandos" as they repaired combat craft over route from U. S. through nine countries to China. Here they overhaul a C-46 Commando, one of cargo planes which moved outfit over Hump. (CBI ATSC photos.)



ATSC mechanicommando Service Group is self-contained mobile unit doing all kinds of work for Air Force units, from cooking to financing. These signal men are attached to group repair communications at present China base.

DEEP IN CHINA TODAY there is an ATSC Service Group which finally found good bedding and table crockery the hard way.

Commanded by Col. Paul A. Cunyus, the outfit started for the wars in the summer of 1942, repairing and rebuilding combat planes three-quarters of the way around the world through nine countries, but seldom seeing real beds or much of anything in the way of food but C and K rations.

China, their latest but possibly not last stop, was reached last spring when they were ordered over the Hump by Maj. Gen. T. J. Hanley, Jr., commanding the then Air Service Command in CBI, to apply their battle experience to fighter squadrons of Maj. Gen. Chennault's 14th Air Force.

A Service Group of the ATSC is actually a task force of airplane supply and maintenance, geared to be mobile and self-sustaining. Along with the basic squadrons of repair and supply, a Service Group has what are known as "attached arms and services"—companies and squadrons of Ordnance, Quartermaster, and Signal Corps, and detachment personnel of Finance, Chemical Warfare, Chaplain, and Special Service units.

The log of Col. Cunyus' "mechanicommandos" discloses how this well-knit junior army of ATSC operates to help not only the individual tactical air squadrons of the AAF, but functions at times in the manner of a complete housekeeping force for the entire Air Forces or Sector Command with which it is currently affiliated.

The China-ward trek started from an Atlantic Seaboard port of embarkation, touched at South America and South Africa, and disembarked for the first of many stops at Suez just as Field Marshal (then General) Sir Bernard Montgomery was pressing the button for the battle of El Alamein and the rout of Marshal Rommel's Afrika Korps.

The men lived in English-type tents and ate English rations in Egypt. None of their equipment had arrived from the United States, hence they were forced to borrow and beg tools

(*Continued on page* 193)

The B.F. Goodrich Airplane of the month

NORTHROP P-61 "BLACK WIDOW"

Largest and most powerful pursuit plane ever flown, the Northrop Black Widow was built to attack the enemy by night! But she is also being used successfully in daytime combat operations. She's fast; she's deadly; she's different! Her two- or three-man crew put her through the most difficult maneuvers with the greatest of ease . . . operate the heaviest fighter plane armament in the world . . . and bring her in to land at remarkably low speed for such a heavy, fast airplane.

Many B. F. Goodrich products are now flying on all fronts with the Black Widow . . . and with other winning warplanes all over the world. Silvertown Tires, De-Icers, Bullet-Sealing Fuel Cells, and Expander Tube Brakes are helping to get our fliers off and back!

To the Black Widow now making headlines . . . and to her maker, Northrop Aircraft, Inc., B. F. Goodrich tenders a well-earned salute—our nomination of the Black Widow as "Plane of the Month."

In war or peace

B.F.Goodrich

FIRST IN RUBBER

NEW DE-ICER PASSES HIGH-SPEED TEST!

B. F. Goodrich Type Eleven operates successfully on fast fighters!

FOR MORE THAN A YEAR this new De-Icer has been under test for ice-removal efficiency . . . for service life . . . for performance at high speeds. The latter test resulted in the approval of Type 11 De-Icers *for use on fighter aircraft!*

The Army wanted proof that these De-

YEAR'S SERVICE TEST PROVES SUPERIORITY OF B. F. GOODRICH TYPE ELEVEN DE-ICERS

Icers would stand up under the terrific speed strain—proof that De-Icers would be practical for fighters. A recent test gave them the answer.

One of the fastest fighters, a P-61 Black Widow, was equipped with Type 11 De-Icers. This airplane was operated at various high speeds and the De-Icers proved satisfactory on all counts. Army acceptance was granted.

Today, after many successful years on transports, airliners and bombers, B. F. Goodrich De-Icers *for fighters* are in production.

ONE of the most grueling tests a De-Icer was ever put through took place over the past year. A B-24 was equipped with Type 11 De-Icers and sent ice chasing. For over a year its crew looked for icing conditions and, when no ice was found, it was made artificially by special equipment on the airplane so that they could give the new De-Icers every chance to prove their effectiveness. They never hangared the plane during the test period . . . leaving it out in blinding sun, sand, sleet and rain . . . so that the De-Icers would age much more rapidly than normal. The airplane actually logged 380 hours during the test. *The De-Icers were in operation 150 of these hours.* Subsequent inspection at the factory showed they were still in satisfactory condition and good for many months' service.

The Type 11 De-Icer operates on the same principle as B. F. Goodrich De-Icers now in service. The greatly improved performance indicated by the tests above is the result of refinements in design and construction briefly outlined at the right. If you are interested in more complete data on this new, more efficient Type 11 De-Icer, write today to The B. F. Goodrich Company, Aeronautical Division, Akron, Ohio.

NEW FEATURES OF THE B. F. GOODRICH TYPE ELEVEN DE-ICER

- **Smoother Cross-Section:** Attachment edge is thinner, reinforcing strips are eliminated, tubes are recessed.
- **Improved Tear-Resistance:** The result of a new all-over surface ply of special elastic fabric.
- **Improved Tubes:** Sponge filler and reinforcement strips have been eliminated; rubber and fabric have been used more effectively.
- **Better Ice Removal:** The result of more effective tube arrangements, made practical by the stronger, lighter materials.
- **Longer Life:** New De-Icer installs with less strain on the rubber, lengthening its useful life.
- **Reduced Maintenance:** Most of the features mentioned here contribute to lower maintenance requirements and costs.

All these refinements for better performance have been accepted by the CAA and the Army Air Forces.

Skyway or Highway

B.F. Goodrich

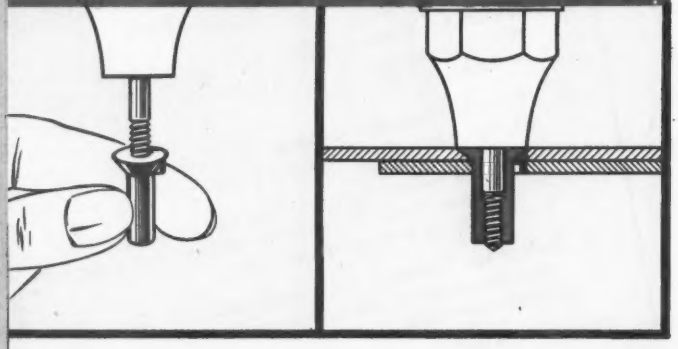
FIRST IN RUBBER

NO OTHER BLIND FASTENER HAS ALL THESE ADVANTAGES

They're all good reasons why B. F. Goodrich RIVNUTS deserve a place in your plans!

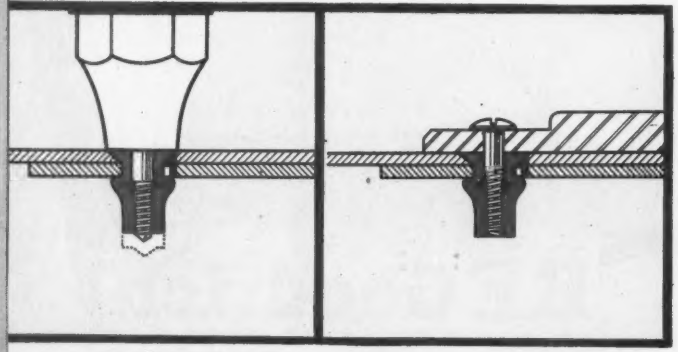
- **Dual use—can serve as a blind rivet, as a nut plate for attachment, or as both at once**
- **Simple, one-piece construction**
- **Unusually wide bearing surface**
- **Requires very small hole**
- **Forms a compression fit**
- **Quickly installed**
- **Economical**
- **Ready for use as received**
- **Wide range of types and sizes for use in wood, metal or plastics**
- **Available with key to increase torsion resistance**

RIVNUT INSTALLATION IS SO EASY EVEN A BLIND MAN CAN DO IT!



1 Rivnut is threaded on pull-up stud heading tool until it touches the anvil.

2 Rivnut and pull-up stud are placed in holes with Rivnut head firmly against, and at right angles to, the work.



3 A squeeze on the tool lever retracts the pull-up stud slightly, causing lateral bulge upset of the Rivnut.

4 When pull-up stud is removed, the Rivnut can be used as a nut plate. Threads grip accessory screw firmly.

ALTHOUGH DEVELOPED primarily as a nut plate for the attachment of De-Icers, Rivnuts have found many other important uses in aircraft construction. Typical fastening applications by leading manufacturers include assembling cloth-covered wings, ailerons, rudders, etc.; attaching fillets and fairing, door and window frames, access panels, insulation, light frames and the like; fastening panel board fixtures, bonding wires, clips, brackets, flooring.

FREE! Today, send for your copy of new folder, "Rivnut Data." Gives full facts—Rivnut sizes, grip ranges, weights, strength, etc. For yours, just write to The B. F. Goodrich Company, Aeronautical Division, Akron, Ohio.

B.F. Goodrich

RIVNUT

IT'S A RIVET...IT'S A NUT PLATE

and transportation from the British stationed in permanent garrison camps. Not a single American vehicle was available at this time, but the group managed to acquire a few beat-up vehicles from the RAF.

An old Italian truck was discovered in an English dump and hauled into camp where mechanics overhauled it and made it "useable". This was the first vehicle the globe-trotters could call their own; they named it the "spaghetti wagon". The ancient vehicle traveled with them from then on —across the Western Desert into Tripoli, then up into Tunisia. Later it moved into Malta, Sicily, and Italy. It is now in India awaiting trans-shipment over the Hump into China—still arousing comment whenever seen by American personnel or Allied troops.

During the Egyptian stop, the Group served a heavy bombardment group that flew in support of the British 8th Army, pounding Tobruk, Benghazi, shipping in the Mediterranean Ocean, and installations of Marshal Rommel's Afrika Korps.

The rapid advance of the British 8th following the breakthrough at El Alamein dictated the first move for the Service Group—to Gambut, 25 mi. below Tobruk, in the Great Western Desert, sometimes called the Libyan Desert.

The Gambut section of the Western Desert was as barren and desolate as anything one had ever seen in "sheik" motion pictures. There was a loose top-layer of sand throughout the area, constantly being picked up by the wind to swirl over everything. It covered the food, equipment, bedding, and clothing of personnel.

At times, sandstorms of three and four days' duration raged, causing all work to cease. It was impossible to see more than three or four feet, yet all this while the bright desert sun was shining. The men were given cans of emergency rations and stayed in their tents from morning to night until the dust and sand storms had abated, then they went to work.

At this time, elements of the Service Group moved to Benghazi, where they helped the British repair the port and fix the lines of communication. Another detachment moved to Marble Arch, a few miles behind the then-current lines, where they handled the supplies and freight which American Troop Carrier planes were flying to the forward elements of the British army.

At Gambut, these crewmen serviced two other bombardment detachments, in addition to the heavy bombardment group they had moved along with from Egypt. The heat and sand storms, combined with the scarcity of water, made this specific spot particularly uncomfortable. Water had to be trucked from Bardia, 35 mi. away. Each man was alloted one canteen of water a day for washing, shaving, and drinking.

The only part of the Service Group in operation at this time was the repair squadron; the other men filled in at various jobs with the bomber groups and with their own organization. From Gambut, the travelers moved to Castel Benito Airport, Tripoli.

(*Turn to page 272*)

Top, left: Egypt was first stop, where group serviced air arm which helped drive Rommel's Afrika Korps from Mediterranean area. Top, right: Republic P-47 gets new empennage in North Africa. Above, left: Moving into Malta, where group raised first American flag ever flown by military unit on that island. Above, right: Gen. Stilweli welcomes Col. Paul A. Cunyus' globe-trotting Service Group to China. Said the colonel to the general, "There's just one place left for this outfit to go and that's home—but only via Japan." C, D, E, F.

Service and a Paintbrush Bring and Hold New Business

By WILLIAM D. STROHMEIER

Hawthorne Airmotive doubled the number of planes it stored and serviced and quadrupled student business in less than a year. Here's how it was done—and how any other operator can do the same thing.

JENNINGS AIRPORT, the municipal field for Orangeburg, S. C., has more than doubled its number of planes and quadrupled its student business in less than a year — a marked growth which is, virtually, the story of what a paint brush and a little imagination can do for any small-town airport.

Today, Jennings Manager Ralph C. Crocker claims he has more private aircraft stored on his field than any other airport serving a town of equal size. His 23 airplanes in a town of 12,000 people (half the population is composed of Negroes) is a record which he believes is unequalled by any other town in the country. "If other towns can claim to have done better," he says, "we'd like to hear from them."

In all respects, Jennings Airport is a typical small-town field. Its 95 acres were acquired by the city 10 yr. ago, and in 1936 a 60 x 80-ft. steel hangar was constructed. A small office — 12 by 20 ft.— made up the balance of building facilities.

A year ago nine airplanes were stored comfortably on the field and one airplane operated by the local pilot-operator took care of all the student business. Now five airplanes are kept busy handling student and private pilot business, and the field is a hub of activity for all of southern South Carolina.

Easing of civil air regulations and the fact that the Hawthorne School of Aeronautics, which operates a large Army contract primary school nearby, are not the only reasons for Jennings' new lease on life. The manner in which business has been handled and the improvements which have been effected on the field have been more responsible for this improvement. Here's what happened at Orangeburg, and here's what could happen at any airport under heads-up business-like management:

In Feb. 1943, operating rights on Jennings were acquired by Beverly Howard, well-known southern operator and president of the Hawthorne operations. Hawthorne Airmotive was then set up as a separate company to operate Jennings. The venture presented a departure for Howard, who has always operated on large municipal fields, such as at Charleston and Columbia, S. C.

Howard was convinced that operations on small airports could be more than a one-plane hip-pocket proposition. Principles of service to transient and local plane owners, organized instruction, and well-controlled flight operations, which apply to large airports, could be utilized equally as well on smaller fields, he felt. The success of Hawthorne Airmotive's first year and a half of operations proves that even small airports can provide decent service, and at a profit.

Almost the first thing that happened when Airmotive moved in was a thor-

Left: Typical personal plane owner now basing at Jennings Airport is Tom Summers, who owns local jewelry store, shown here with his Taylorcraft. Smart service has helped Hawthorne Airmotive attract unusually large number of plane owners to field. Right: This porch, with gravel floor and chairs, cost less than $50 but has already more than paid for itself by attracting new business.

ough painting of the place. The small operations office was painted inside and out, the hangar was cleaned up, and the shop was put in neat order. A flag pole was set up next to the hangar, adding much to the smartness of the place's appearance. In this regard, emphasis on this one item cannot be stressed too highly. Without appearing to suggest exploitation of the national flag as a business-getter, the fact remains that the flag adds 100 percent to the outward appearance of any field. An airport is simply one of those places where a flag belongs. It also gives flyers a line on wind strength and direction.

The next important addition to the flight line was a parking line to assure orderly parking of planes on the field. This is both a service to owners and a protection for them, since helter-skelter parking of airplanes is conducive to locking wings and taxiing into hangars and other obstacles. The line was laid down 75 ft. from the hangar and parallel to the edge of the field. Crossmarkers, the width of average light plane treads, were marked on the line, allowing an average of 5 ft. between wing tips of parked planes. At each of the parking stations tie-down ropes are attached to "deadmen" in the ground.

One of the phases of good airport operation which always impresses transient pilots and which induces them to

(*Turn to page* 265)

Jennings Airport operations office is neat and compact, with flight equipment—which means added revenue—attractively displayed. Shown are Manager Bud Crocker; Mary Shatlock, one of two girl employees; and C. L. Lake, Orangeburg electrician and Cub owner-patron of airport.

Local as well as transient pilots are parked by alert linemen using standard Army technique. Note white parking line and position for wheels indicated by cross lines. (P. M. Hannum photos)

from GI *to* Blue Denim

HOW BREEZE
Can Help You!

Write today for your free copy of "A Solution To Reconversion." This 24-page, fully illustrated brochure tells how Breeze engineering and manufacturing experience and facilities can help solve your reconversion problems.

When war struck, American business accomplished the tremendous change-over from Peacetime to Wartime production with speed and efficiency. Soon, we hope, the cycle of conversion will be completed, as our industries go back once more to the production of peacetime goods.

Breeze was ready, when the call came, to swing all her facilities into the line of march. Now, with greatly increased plant area and production potential, backed by the knowledge that Breeze products have stood up under the grueling test of wartime service, Breeze will be in a position to answer the demands of peacetime industry with a minimum of delay.

Meanwhile, the men and women of Breeze are working day and night, producing such dependable products as Breeze Radio Ignition Shielding, Multiple Electrical Connectors, Aircraft Armor, and Cartridge Engine Starters — products that are helping the United Nations to Victory on world battlefronts.

Breeze BREEZE KEARNY

CORPORATIONS, INC. NEWARK, N.J.

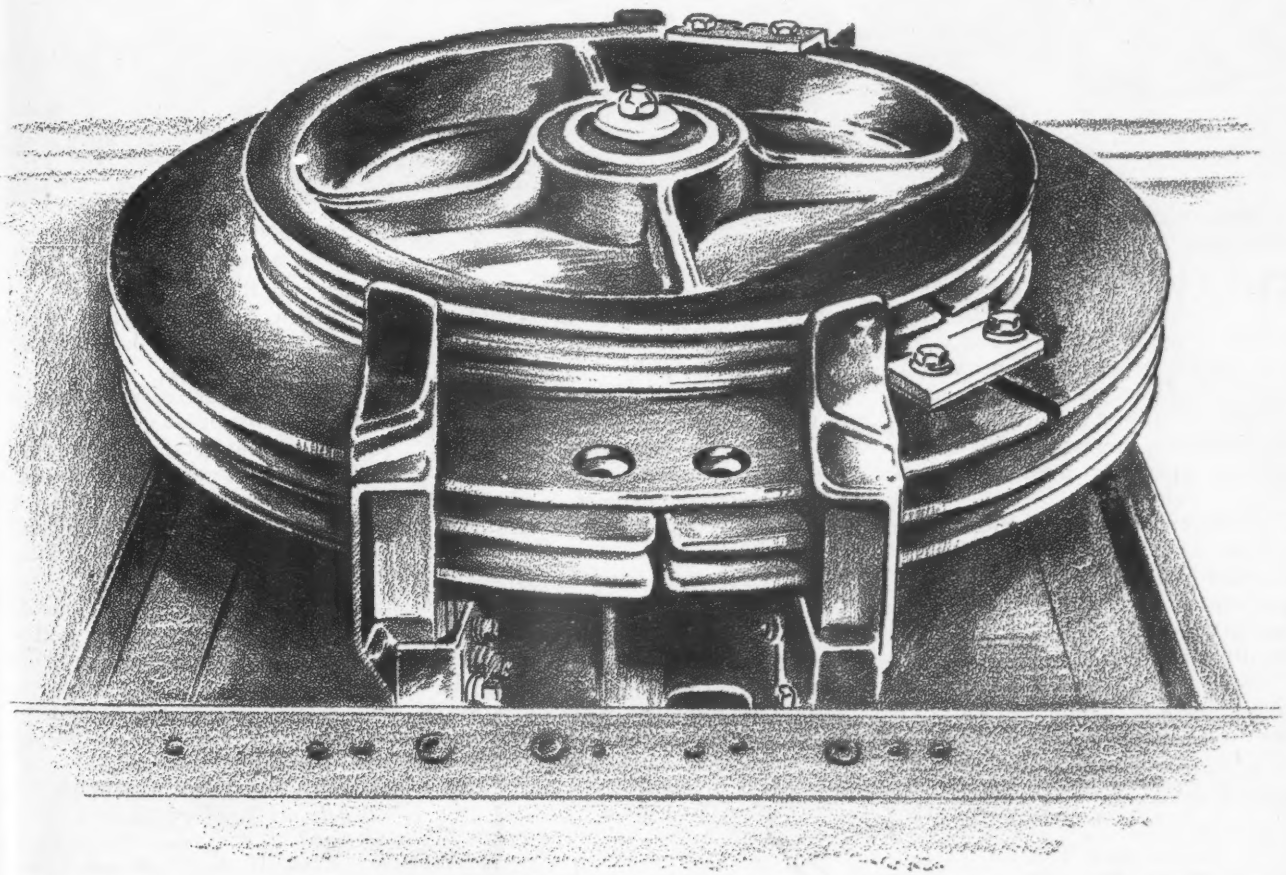
PRODUCTION FOR VICTORY — PRODUCTS FOR PEACE

AVIATION'S *New Regular Feature*

FOR *Better Design*

PLASTIC SERVES FOR AILERON QUADRANT

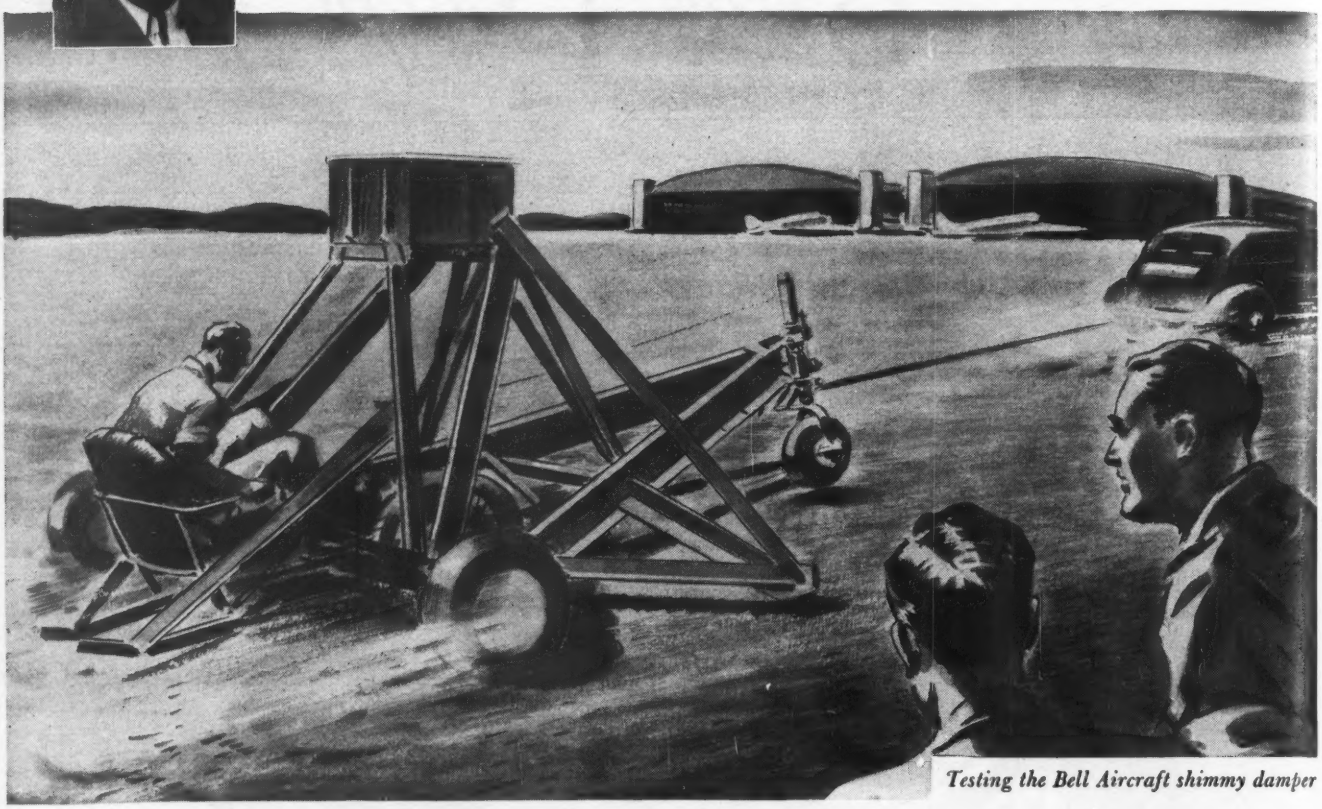
ILLUSTRATED is weight-saving plastic aileron quadrant installed in wing of Martin B-26 Marauder. Compression-molded from mascerated fabric-base phenolic (Celeron), the quadrant weighs slightly more than 7 lb. as against almost 8 lb. for similar unit originally designed in aluminum alloy. In addition, plastic quadrant outwears metal counterpart.



DESIGN FOR SAFER LANDINGS

BY FRANK A. TICHENOR

Publisher of Aero Digest explains the action of the Bell-designed shimmy damper now in use on many U. S. planes employing tricycle landing gear



Testing the Bell Aircraft shimmy damper

"THE tricycle landing gear provides definite advantages—elimination of ground looping, and nose-over hazard, superior ground vision, improved ground handling and maintenance, simplified landing and take-off procedure, increased pilot safety, and easy operation from small, improvised fields.

"However, when first developed, the tendency of the nose wheel to shimmy or caster hampered its use by setting up a vibration so great that there were cases in which the nose wheel strut was literally ripped out of the fuselage.

"A former Bell Aircraft sales executive—now a Lt. Colonel in the AAF who wears the Distinguished Flying Cross—and two Bell engineers, ingeniously helped to solve this problem with the shimmy damper—a control which helps keep the nose wheel from rotating more than 60° to the left or to the right.

"Located in the bottom end of the nose wheel strut, it consists of two fixed vanes and a wing shaft on which there are two vanes. This assembly is filled with fluid.

"When the nose wheel tends to turn, the pressure of the wings forces this fluid through a metering orifice which in turn is further controlled by a thermal valve—thereby dampening the motion of the nose wheel's lateral reaction. The only outlet for the fluid is through the valve, which can be adjusted to stiffen or ease up the nose wheel action in accordance with the pilot's requirements.

"The wing shaft can rotate only in a radius of 120°, because of stops which prevent further rotation.

"War planes now land and take off in jungles and from icy steppes as smoothly as at any of our modern airports at home, thanks to this kind of pioneering.

"The shimmy damper is one of the many contributions which Bell Aircraft has made to the progress of the aircraft industry."

★ *Buy War Bonds and Speed Victory* ★

MEMBER AIRCRAFT WAR PRODUCTION COUNCIL...EAST COAST, INC.

BELL *Aircraft*

PACEMAKER OF AVIATION PROGRESS

NIAGARA FRONTIER DIVISION
Buffalo and Niagara Falls, N. Y.
Airacobra (P.39) and Kingcobra (P.63)—Fighters
Airacomet—America's First Jet Propelled Plane
The Bell Helicopter

ORDNANCE DIVISION
Burlington, Vt.
Flexible Gun Mounts and other ordnance materials

GEORGIA DIVISION
Marietta, Ga.
B-29 Boeing Superfortress

© *Bell Aircraft Corporation*

WINDOWS FOR TERMINAL CONNECTIONS

FIG. 1

AN EFFECTIVE INSULATION for terminals of 00, 0, 2, and 4-size cables on Northrop's P-61 Black Widow is provided by transparent Irv-o-lite sleeves. Adoption of the insulating material and method of installation was conceived by W. S. Drew of Northrop's electrical department.

Approved by the Army, the new transparent insulation (Fig. 1), affords a quick permanent installation permitting instant visibility for inspection of soldering and numbering.

The insulation is applied by insertion of a beveled air hose fitting (Fig. 2) under the sleeve end, compressed air expanding the tube for slipping over the terminal.

Formerly, terminal connections were wrapped with tape (Fig. 3) and coated with methyl-cryolite. Later, in final assembly inspection, the tape was removed to check soldering and then required another wrapping operation.

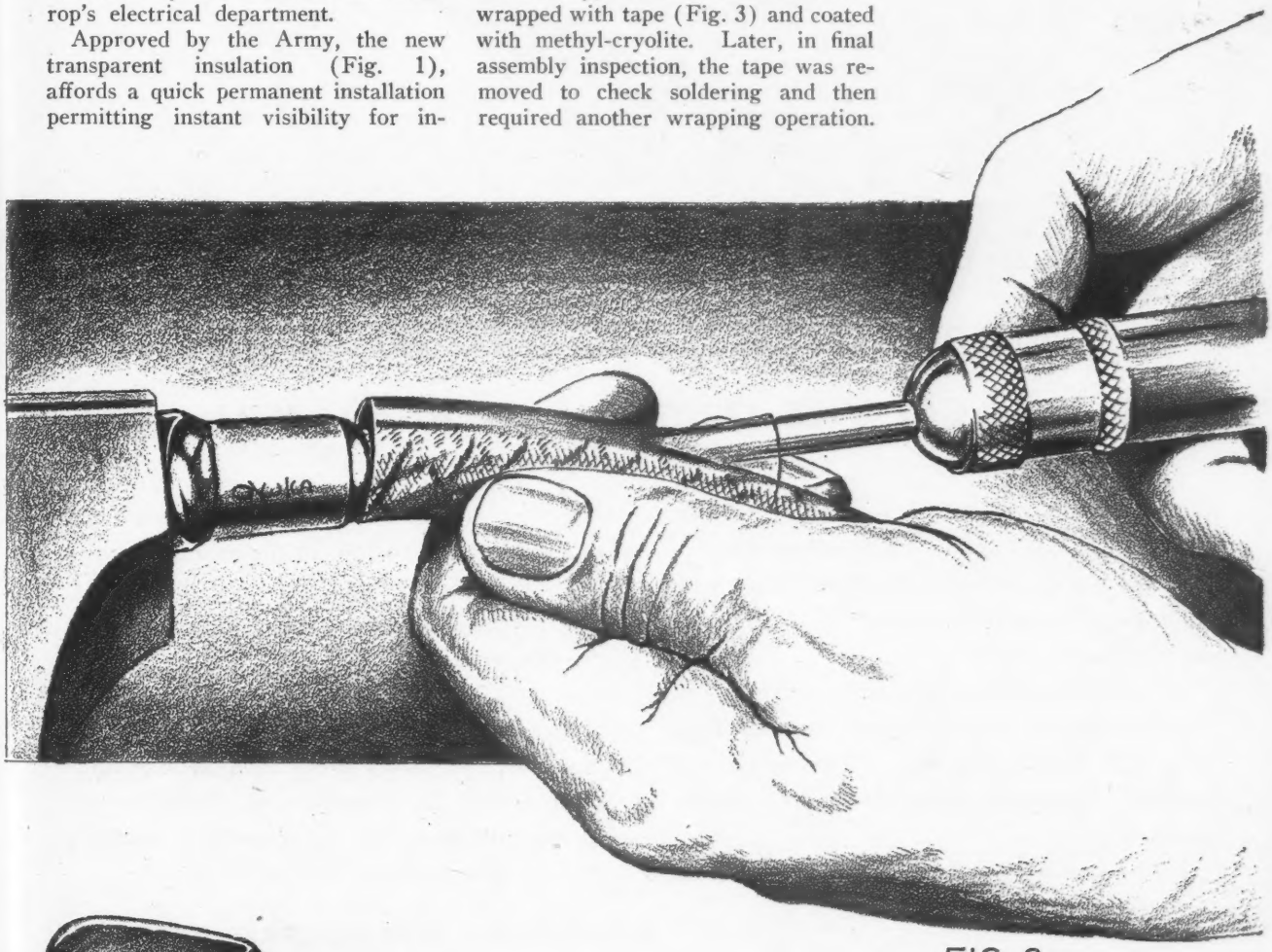
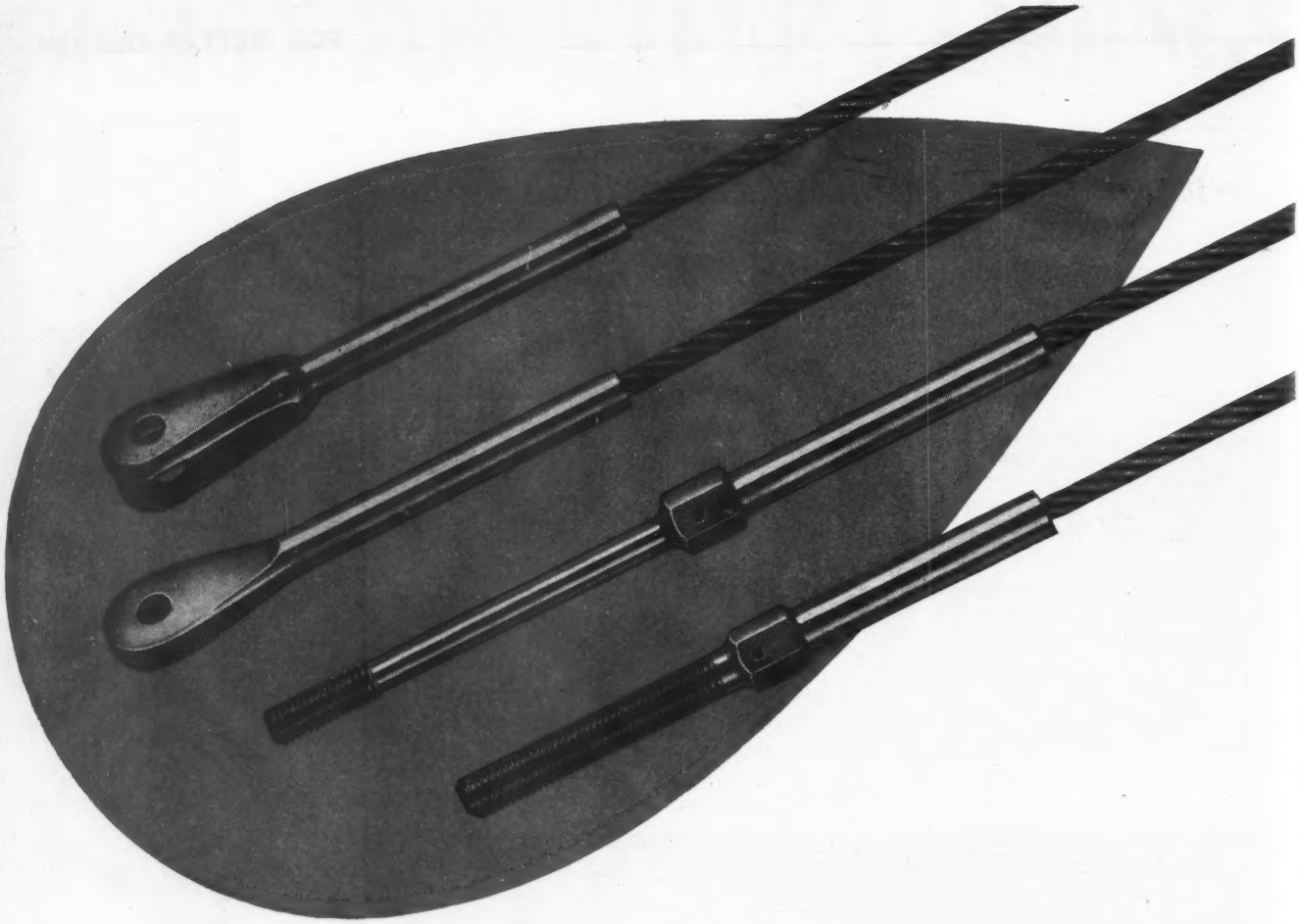


FIG. 2

FIG. 3



SPECIFY TRU·LOC TO MAKE SURE THAT YOU GET THE ORIGINAL SWAGED TERMINALS

As the aircraft industry developed, American Chain & Cable Company, Inc., instituted a continuous program designed to actually anticipate demands that would be created by advances in aircraft design.

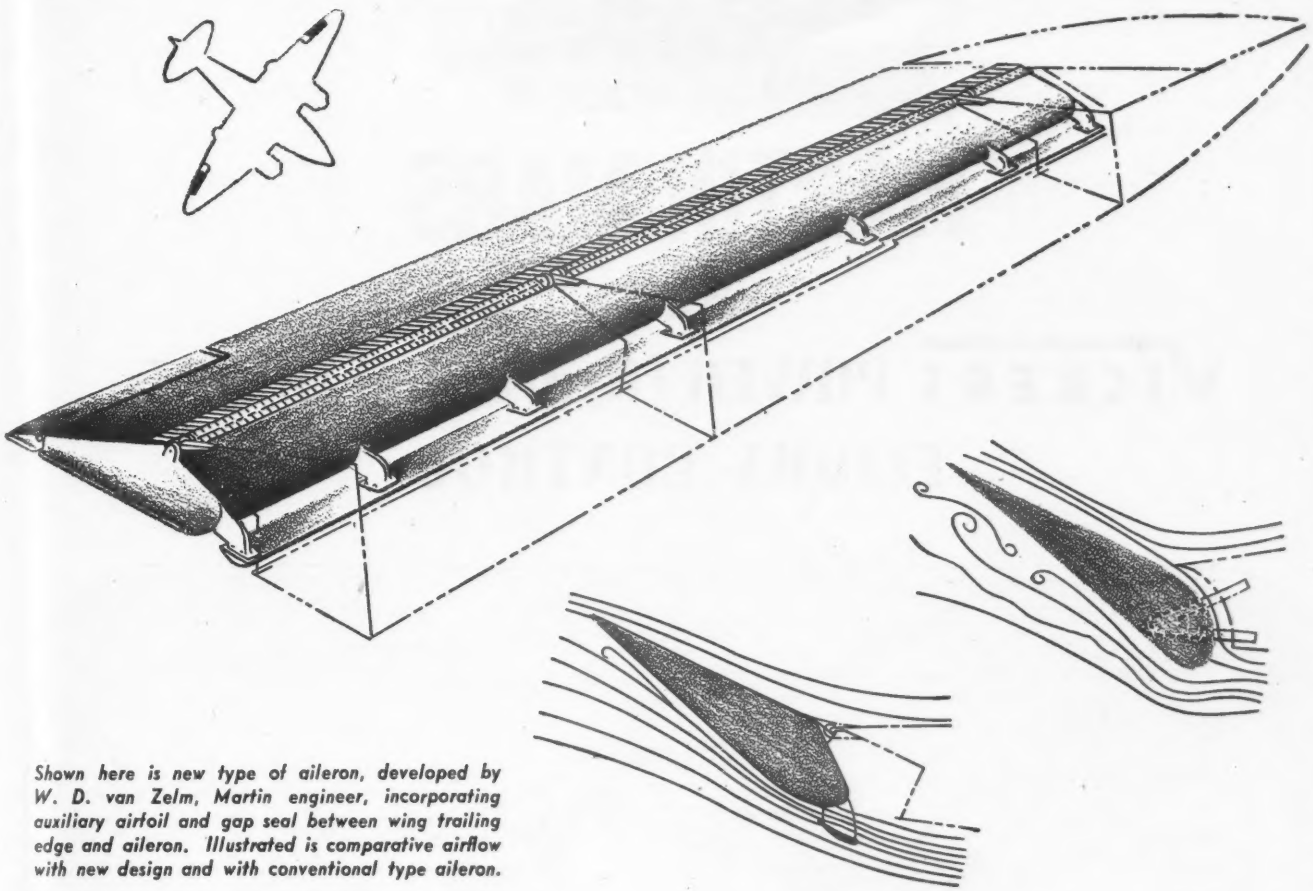
This program has already produced Center Pull Loop Fittings for secondary controls, Ball-Type Swaged Terminals and Ball with Strap Control Terminals—to mention but three of its concrete results.

It was—and is—a definite part of the program to develop the so-called "standard" sleeve-type swaged terminals so that in dimensions, swaging qualities, final strength and finish they would always be right on the beam. These swaged terminals were originated and patented by the American Chain & Cable Company, Inc.—and it might be worthwhile to remember that when you specify **TRU-LOC** you get Swaged Terminals that represent the greatest experience in the industry with them. For complete data and illustrated bulletin, address our Detroit office.

AUTOMOTIVE AND AIRCRAFT DIVISION
6-235 General Motors Building, Detroit 2

AMERICAN CHAIN & CABLE COMPANY, Inc.
BRIDGEPORT, CONNECTICUT

ESSENTIAL PRODUCTS . . . TRU-LAY Aircraft, Automotive, and Industrial Controls, TRU-LOC Aircraft Terminals, AMERICAN CABLE Wire Rope, TRU-STOP Brakes, AMERICAN Chain, WEED Tire Chains, ACCO Malleable Castings, CAMPBELL Cutting Machines, FORD Hoists, Trolleys, HAZARD Wire Rope, Yacht Rigging, MANLEY Auto Service Equipment, OWEN Springs, PAGE Fence, Shaped Wire, Welding Wire, READING-PRATT & CADY Valves, READING Electric Steel Castings, WRIGHT Hoists, Cranes, Presses . . . *In Business for Your Safety*



Shown here is new type of aileron, developed by W. D. van Zelm, Martin engineer, incorporating auxiliary airfoil and gap seal between wing trailing edge and aileron. Illustrated is comparative airflow with new design and with conventional type aileron.

AILERON DESIGN ALLOWS FOR LONGER FLAPS

A NEW AILERON DESIGN developed by W. D. van Zelm, Martin engineer, supplies the same degree of rolling moment as the conventional Frise aileron while affording a 35–45 percent reduction in span, thus permitting considerable lengthening of wing flaps with consequent increase of capacity load, or shortening takeoff run and lowering landing speed.

Prelimiary research to determine the reasons for lack of effective force of conventional ailerons revealed that the projection caused by the balance portion of aileron leading edge created turbulence beneath the aileron and resulted in a loss of effective roll and increase in control force for up-angles of more than 15 deg.

To overcome this condition, the van Zelm design incorporates an auxiliary airfoil in combination with a seal closing the gap between trailing edge and aileron to smooth the air under the aileron in the up position, meanwhile balancing the aileron with a force in direction of roll, permitting twice the up deflection of conventional type.

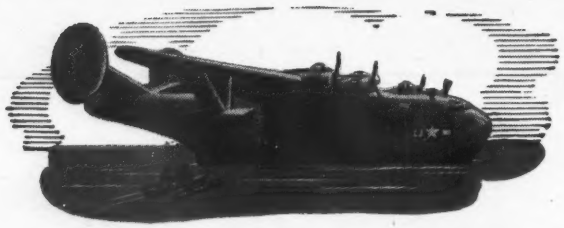
The auxiliary airfoil or slat, extruded from aluminum alloy, is attached to the leading edge of the aileron with metal clips or plates, and in the neutral and down positions fits into a cutout section of the wing trailing edge. The auxiliary airfoil involves no weight addition since it replaces the metal weights used in former ailerons to bring the center of gravity forward of the hinge point to prevent flutter.

The improved assembly employs a top hinge for attaching aileron to trailing edge. This removes restrictions on upward deflection while still permitting downward deflection up to 15 deg. (the same amount provided by the conventional center-hinged aileron) because of the cutout section in the trailing edge. The top hinge also simplifies the problem of sealing the gap between aileron and trailing edge.

The seal, a spring-metal strip attached to the top of the aileron, runs under a bulb section at the wing trailing edge. Since contact with the trailing edge is very close to the hinge line, friction is held to a minimum. Whereas the principal function of the seal is to provide smooth airflow in conjunction with the auxiliary airfoil, it offers the added advantage of eliminating drag (wind tunnel tests have shown that no drag results from irregularities at the bottom of the gap when the top is sealed) and tends to prevent the formation of gap-ice, which might lock the controls.

Further advantages claimed for the new design include: Greater rigidity, since the hinge line is at the wing surface, outside of the aileron contour, and the torque box nose is not cut; better balance through elimination of torque box carry-over structure, reducing weight aft of the hinge; and lower fabrication costs because of simplification of the internal structure.

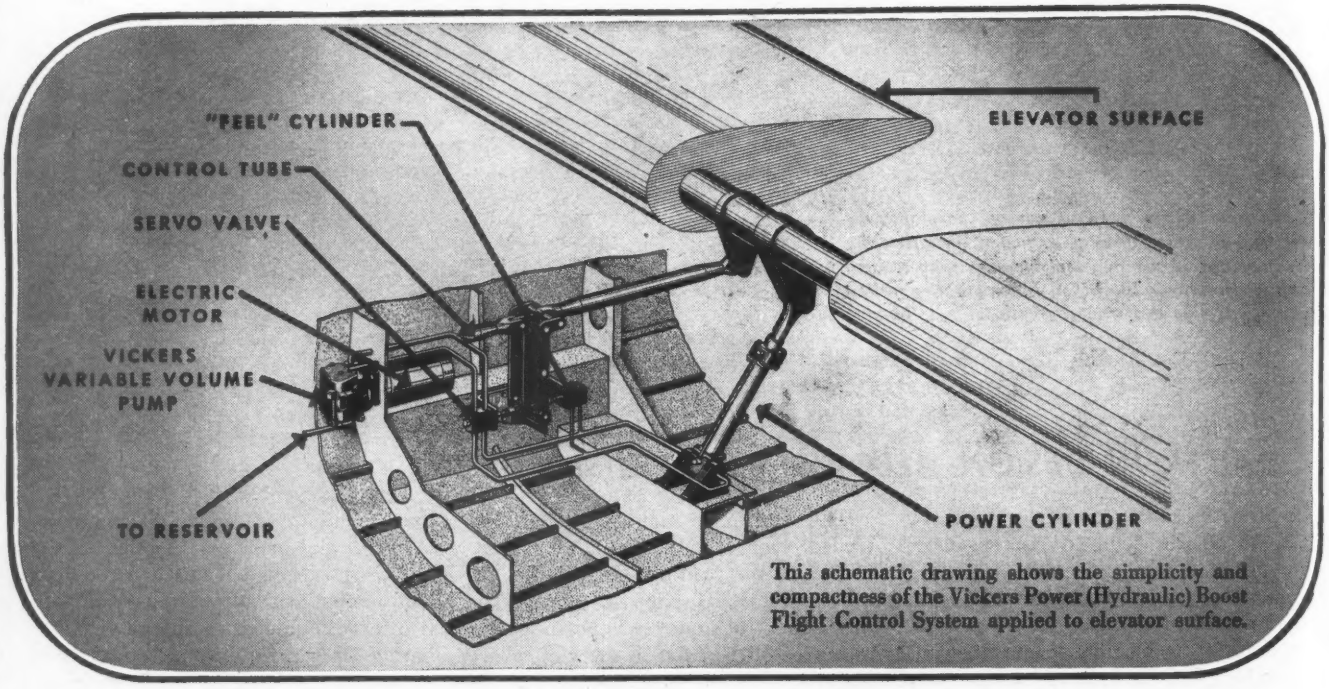
Successfully test-flown on an experimental B-26 Marauder, the van Zelm aileron is being incorporated in designs for postwar commercial aircraft to obtain added lift with consequent greater payloads, and also reduced operating costs.



MARTIN MARS

Has

VICKERS POWER (Hydraulic) BOOST FLIGHT CONTROL



This schematic drawing shows the simplicity and compactness of the Vickers Power (Hydraulic) Boost Flight Control System applied to elevator surface.

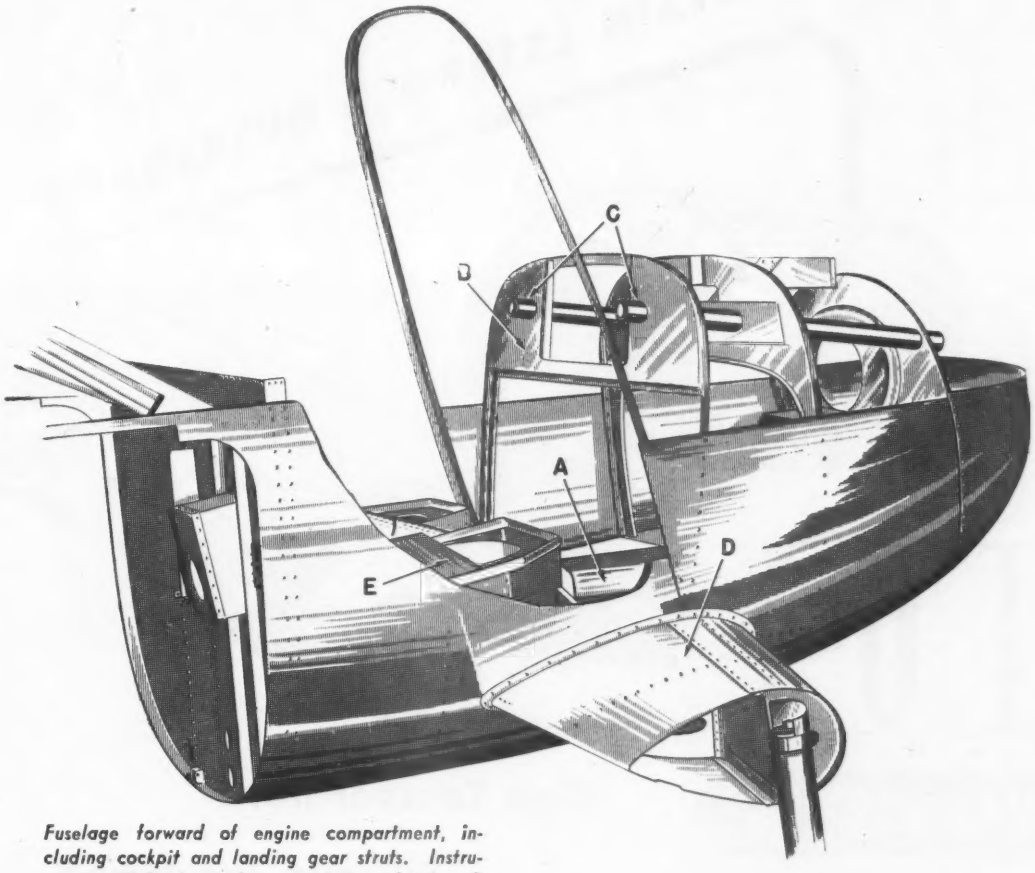
In a paper he presented before the National Aeronautic Meeting of the S.A.E., E. G. Riley, Project Engineer of the Glenn L. Martin Co., enumerated the essential characteristics of a power boost control system as: "(1) proportional feel, (2) feedback and free control stability, (3) immediate and smooth response even after long idle periods, (4) manual standby, (5) instantaneous control by pilot in case of failure, (6) operate satisfactorily under temperatures from minus 65° F to plus 150° F, (7) be capable of being operated by automatic pilot, (8) easily serviced by inexperienced personnel, (9) be relatively trouble-free and have a minimum of adjustment."

In his summary, Mr. Riley made the following statement: "It can be concluded, therefore, that the Vickers power boost control unit is capable of satisfactorily fulfilling all the requirements set forth." This Vickers equipment is now standard on the Mars airplane.

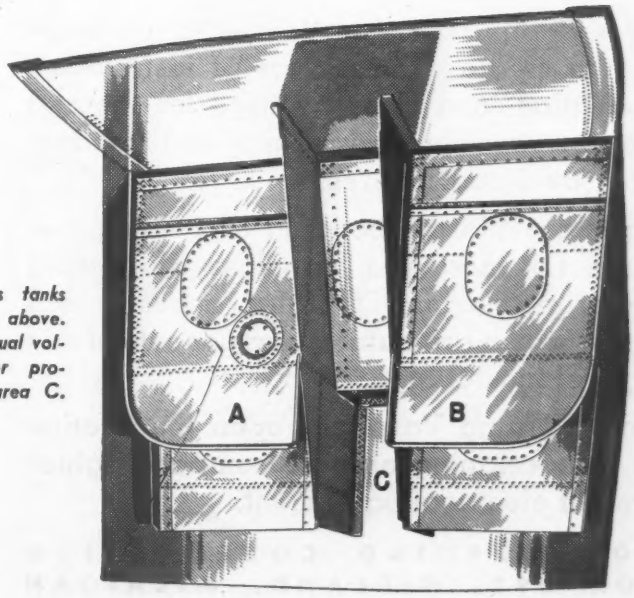
VICKERS Incorporated • 1462 OAKMAN BLVD. • DETROIT 32, MICHIGAN

ENGINEERS AND BUILDERS OF OIL HYDRAULIC EQUIPMENT SINCE 1921

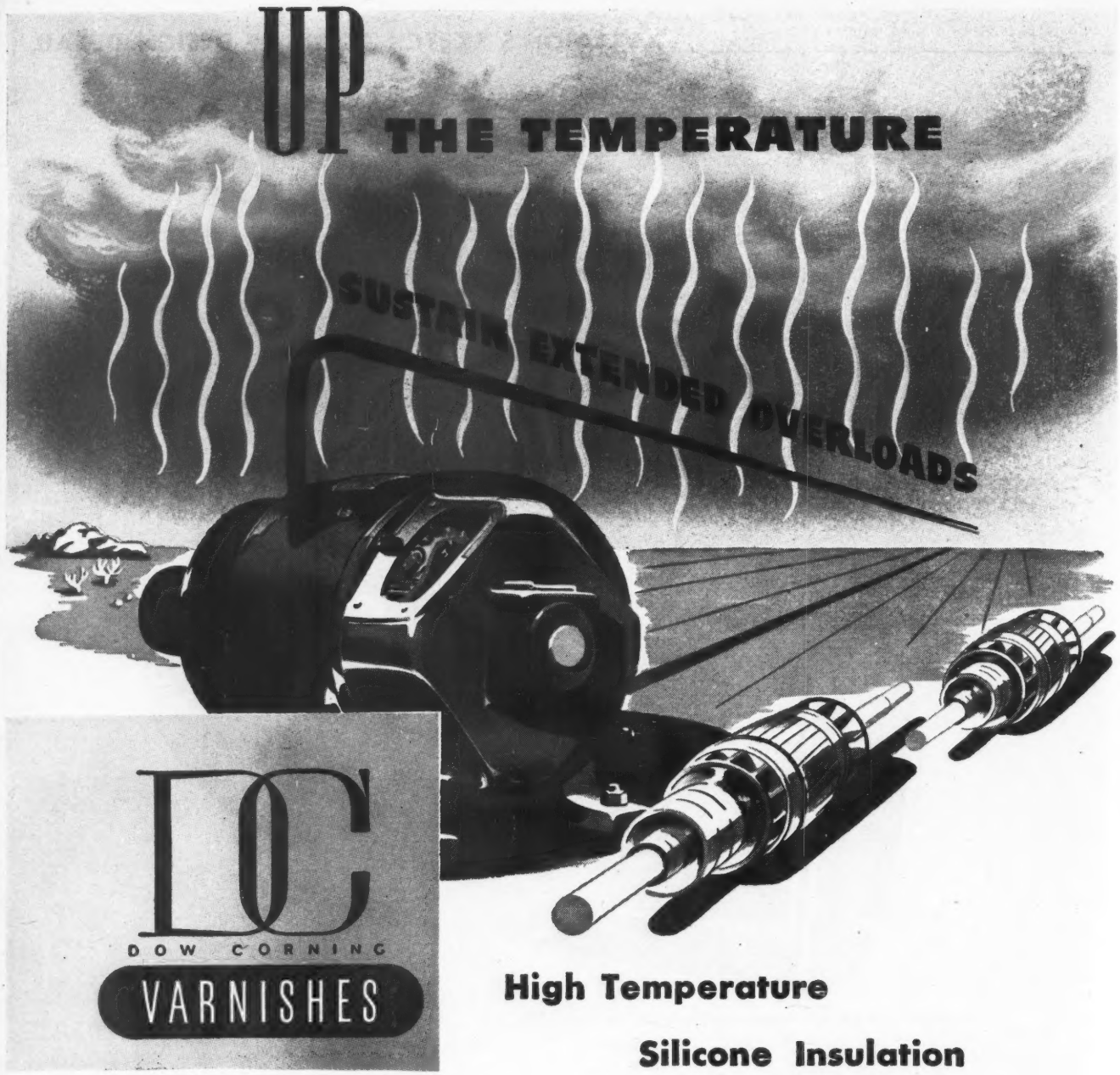
MANY PRINCIPLES of rotary wing aircraft design apply to both helicopters and autogiros alike; in fact many features incorporated in helicopters today have been transferred bodily or adapted. Since so many of the principles can be used in either type craft, AVIATION presents these hitherto unpublished detail sketches of the Pitcairn roadable autogiro as an additional contribution to rotary wing development.



Fuselage forward of engine compartment, including cockpit and landing gear struts. Instruments will be located in panel B, and tubes C house control columns. D is built-up structure supporting landing gear struts, and gas tanks E form base of passenger seats.



Looking down on gas tanks shown in illustration above. Tanks A and B are of equal volume. Drive shaft for propeller passes through area C.



DOW CORNING

VARNISHES

High Temperature Silicone Insulation

Dow Corning Silicone Varnishes are helping to create a new class of insulation—insulation in a class by itself for thermal stability, moisture resistance and freedom from overload failures.

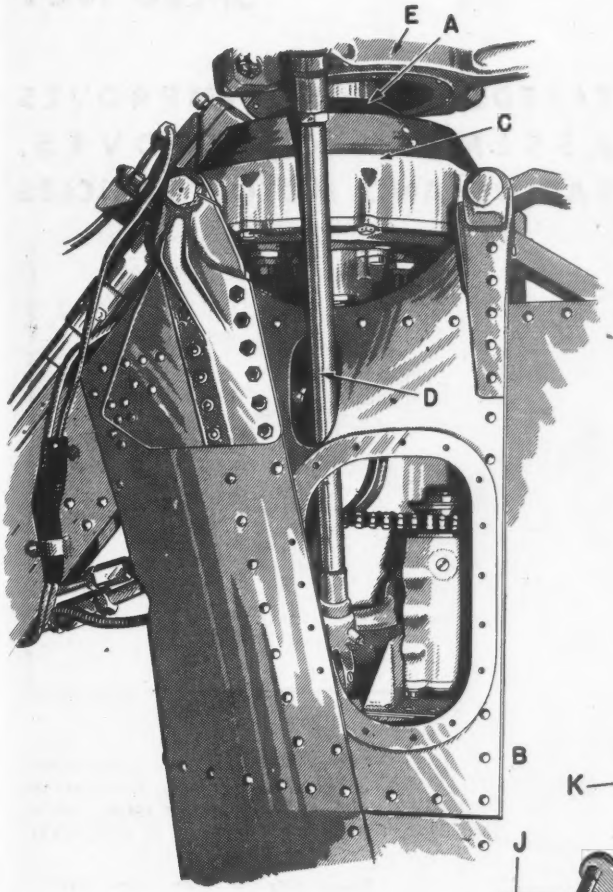
They provide the bonding and filling medium for inorganic, or Class B, spacing materials such as Fiberglas, asbestos and mica, which are natural components of this type of insulation.

Dow Corning Varnishes open the avenue to the designing of more compact, lighter weight electrical equipment.

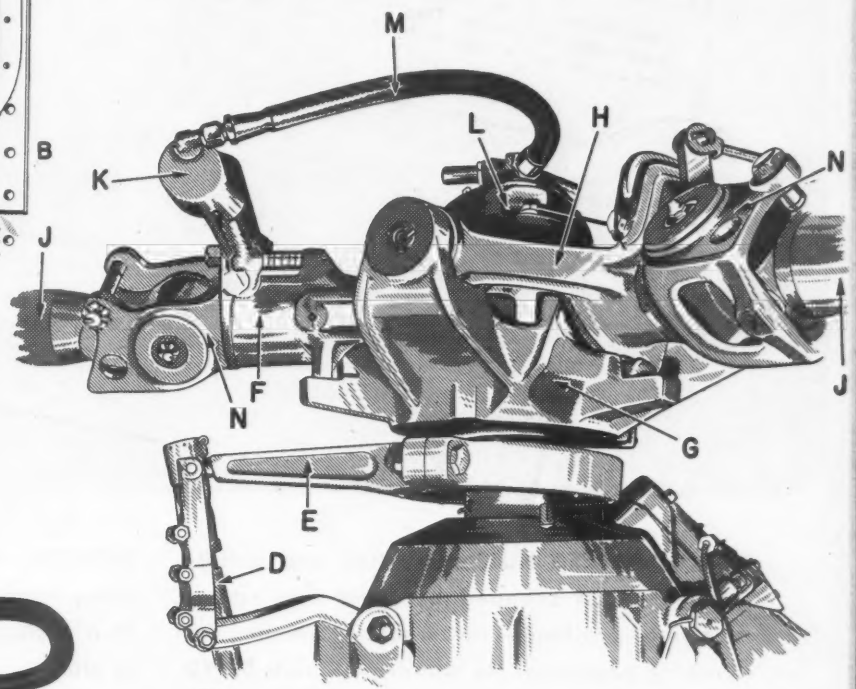
DOW CORNING CORPORATION
BOX 592, MIDLAND, MICHIGAN

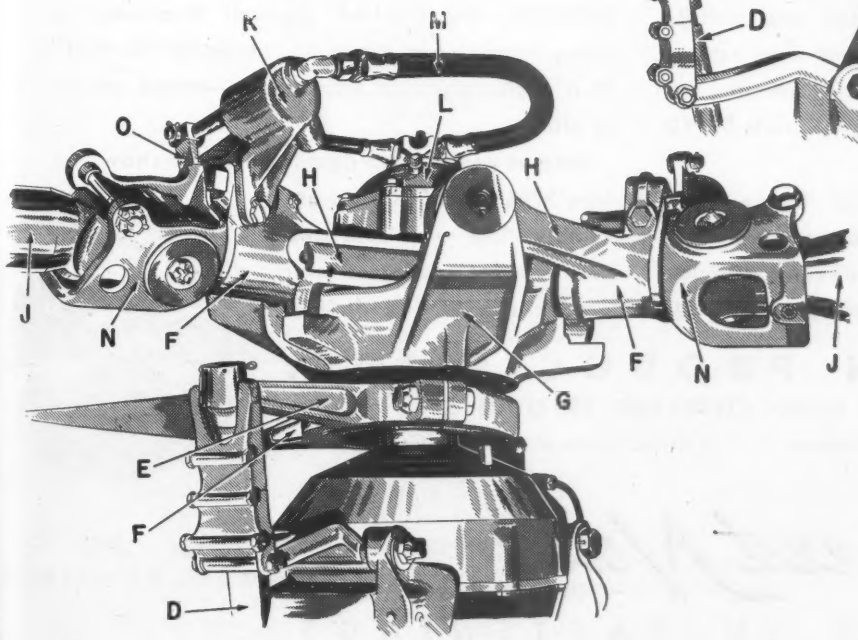
DOW CORNING 993 . . . available in commercial quantities, is a heat curing, high temperature stable silicone varnish for impregnating motor stators, transformer coils and other electrical equipment; for varnishing Fiberglas or asbestos served magnetic wire; for varnishing Fiberglas and asbestos electrical insulating cloths, tapes, tying cords and sleeving; for bonding Fiberglas and mica combinations.

Dow Corning



Detailed view of rotor power transmission and control system. Rotor hub A is supported on rotor pylon B, with power being transmitted through transmission box C. Control rod D is connected to rotor hub through arm mechanism E which moves rotor hub, and thus plane of rotors, to give directional control to craft.

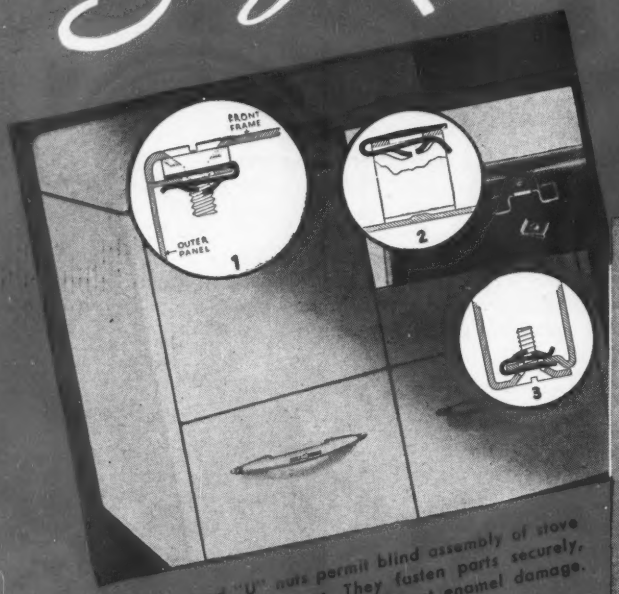




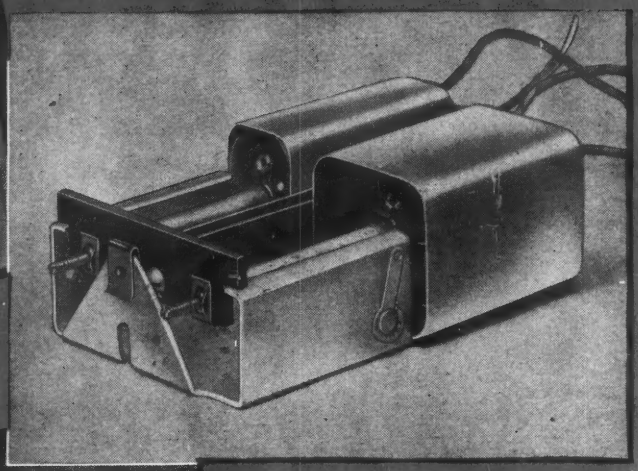
These two views of rotor hub illustrate method of blade control. Control rod D (also shown in sketch above) is here depicted clearly in connection with arm E. Hubs of rotor blades F are attached to main rotor hub G through linkage arrangement H which allows blades to articulate. Angle of attack of rotor blades J is controlled through hydraulic cylinder K. Hydraulic fluid is brought under pressure up through main rotor shaft and out through line L and to cylinder K through tube M. Piston inside cylinder K, thus actuated, turns joint N through arm O. This control arrangement changes angle of attack of all blades simultaneously to increase or decrease rotor pitch.

THE *Self-Retaining* "U" Type SPEED NUT

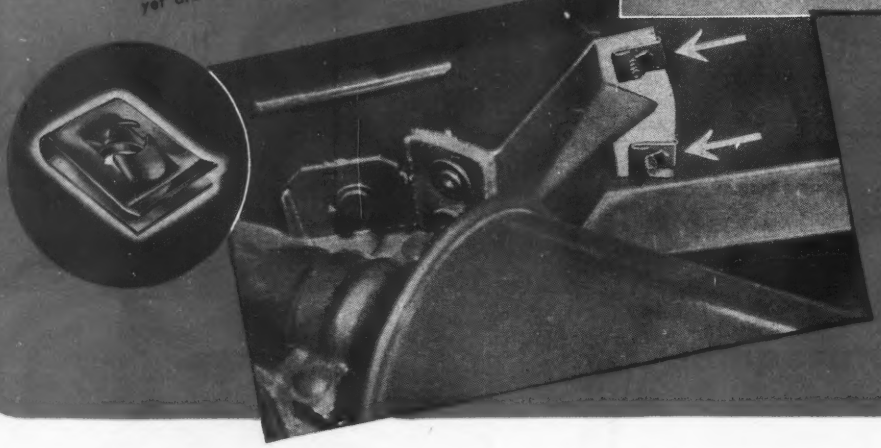
SPEEDS UP AND IMPROVES ASSEMBLY OF STOVES, RADIOS AND MOTOR VEHICLES



Self-retained "U" nuts permit blind assembly of stove panels and door liners. They fasten parts securely, yet are resilient enough to prevent enamel damage.



"U" nuts fit over a fibre bracket holding automatic tuning screws. Spring prongs of Speed Nuts provide correct tension to permit adjustment of core screws.

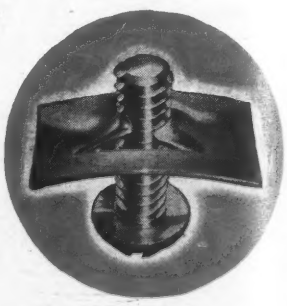


Heavy duty "U" nuts fasten auto muffler bracket to frame. One operator makes complete attachment with power screwdriver, as "U" nuts are self-retained in position.

"U" type SPEED NUTS are easily and quickly applied — just snapped by hand into screw-receiving position — no welding, riveting or clinching necessary. No wonder "U" nuts SPEED UP product assembly!

"U" type SPEED NUTS hold tight — their arched prongs absorbing vibration to prevent loosening. Yet, their resiliency prevents damage to the parts they hold. No wonder "U" nuts IMPROVE the finished product! Available in many shapes and sizes, "U" type SPEED NUTS fit a wide range of thicknesses—metal plastic or glass.

Send us your design details and we'll show you how SPEED NUTS can cut assembly time and cost and improve the quality of your product too. Write today!



TINNERMAN PRODUCTS INC.

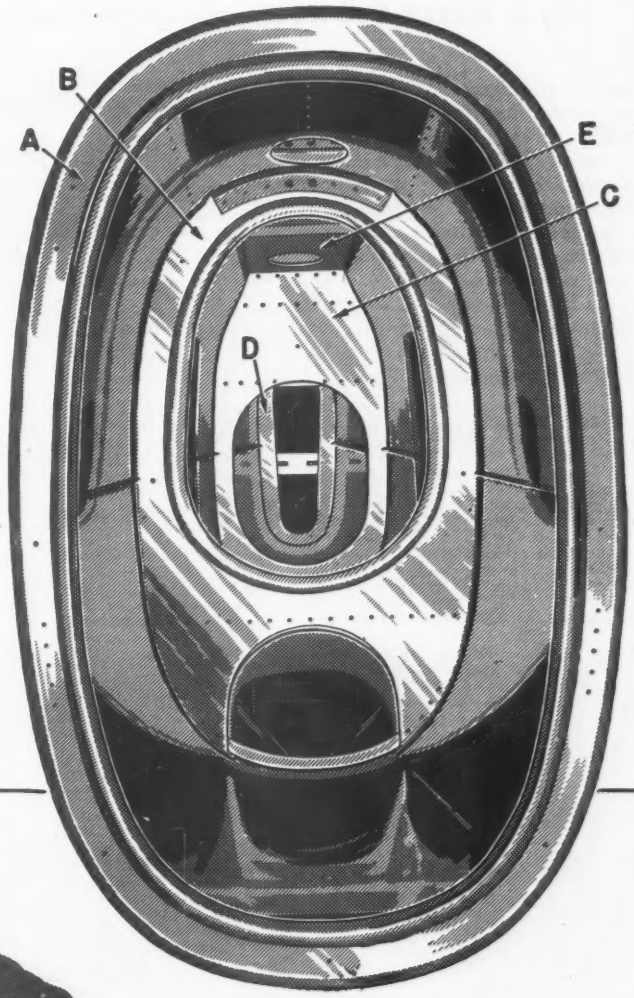
2070 FULTON ROAD, CLEVELAND 13, OHIO

In Canada: **Wallace Barnes Co., Hamilton, Ontario.** ***In England:*** **Simmonds Aerocessories Ltd., London.**

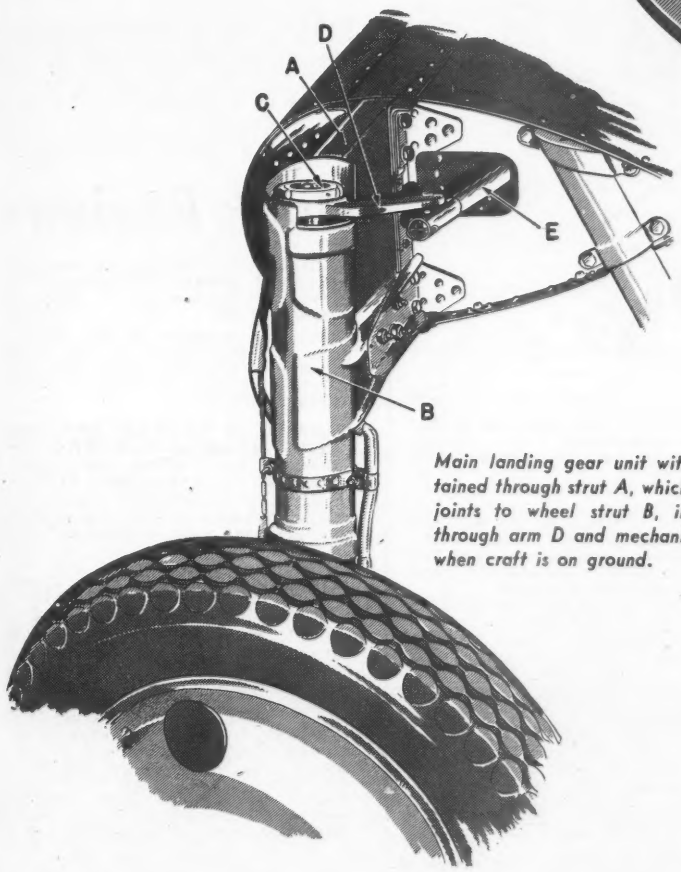
*Speed Nuts** PATENTED

*Trademark Reg. U. S. Patent Office

FASTEST THING IN FASTENINGS



Looking aft inside fuselage from bulkhead directly behind engine. Construction is semi-monocoque, skin being supported by bulkheads A, B, C and D without, however, any stringers between them. Construction of each bulkhead varies slightly, with bulkhead A being a formed ring with rolled inner edge; B flat plate with rolled inner edge, and C and D primarily of flat plate type. Vertical fin is attached to bulkhead C and forward of that to top of fuselage along area E.



Main landing gear unit with fairing removed. Support is obtained through strut A, which is rigidly attached through welded joints to wheel strut B, inside which is shaft C connected through arm D and mechanism E to control wheel for steering when craft is on ground.

Review of Patents

By A. HARRY CROWELL, *Registered Patent Lawyer*

FOLLOWING are digests of some of the more interesting recent patents on aviation developments granted by the U. S. Patent Office. Mr. Crowell will gladly furnish readers with free information on approximate cost and procedure in applying for patents and trademark registration. Address inquiries to him, care AVIATION, 330 West 42nd St., New York City (18). Printed copies of any of patents listed are obtainable at a cost of 10c. each, directly from U. S Patent Office, Washington.

Airplane Pickup Mechanism, employing relatively light inexpensive masts made possible through use of improved catapult release mechanism, has electrical control-switches mounted at upper ends of masts, maintained in open position by flexible element to which package is connected. Disconnection of flexible element from either switch upon pickup of cable by plane hook closes circuit for releasing catapult latch to project package without noticeable drag.—2,356,671, filed May 8, '41, pat. Aug. 22, '44, J. G. Ingres and H. W. Hey, assignors to E. G. Hill and G. T. Smith.

Rotary Wing Invention is intended to correct control difficulties resulting from lateral cone tilt by providing means which utilizes close relationship between longitudinal and lateral component of cone tilt, for purpose of causing cyclic pitch change to suppress lateral component.—2,356,692, filed Feb. 4, '41, pat. Aug. 22, '44, H. H. Platt, assignor to Rotary Research Corp.

Automatic Control for Blade Pitch, employing arrangement of V-belts and pulleys, aims to provide effective inexpensive mechanism having minimum of toothed-gears, responsive to need for change in blade angle.—2,356,772, filed June 7, '43, pat. Aug. 29, '44, R. C. Magee.

Fuel System stated to be especially adapted for multi-engine aircraft provides for transfer of fuel from any tank of group of tanks to any of another group by means of selector valve associated with each group, valves having common port and plurality of distributing ports.—2,356,786, filed Nov. 14, '41, pat. Aug. 29, '44, L. F. Harman and O. H. Snyder.

Airplane Wing Construction method proposes use of metal (aluminum) tubular members, one tube exteriorly surrounding another, the tubes being of different lengths and diameters, secured to each other to attain increased rigidity and strength without increase of customary weight of such elements.—2,356,918, filed Feb. 21, '42, pat. Aug. 29, '44, O. R. Courtney.

Aircraft Fabric Covering Method consists of securing shrunk-taut, woven, mechanically extruded organic filament fabric to cover structural framework of plane, the fabric having at least one impregnating coat of dark opaque cellulosic dope and also a superimposed coating of colored dope.—2,356,927, filed Nov. 9, '40, pat. Aug. 29, '44, D. B. Grossman, assignor to Roxalin Flexible Finishes, Inc.

Rate of Ascent and Descent indicator for aircraft comprises pair of tubes, each open at one end to atmosphere and having opposite end communicating with sealed air container. Indicating element, movably disposed in each tube, responsive to airflow occasioned by pressure in container and prevailing atmospheric pressure, visibly indicates rate of ascent or descent.—2,357,060, filed Aug. 21, '42, pat. Aug. 29, '44, J. Robinson.

Heating System Control affords means for eliminating heavy loads on aircraft electrical generating system by cutting off igniters during interruption in supply of fuel mixture to heaters. Action is accomplished by use of thermostatic switches in special circuit.—2,357,404, filed Dec. 19, '41, pat. Sept. 5, '44, S. E. Heymann and L. A. Williams, Jr. (assignors to Stewart-Warner Corp.) and H. J. De N. McCollum.

Signal for Missing Aircraft comprises container for small electric plant housed in shell of fuselage or other part of craft so that container will be ejected by impact in event of crash or released by water acting as solvent, causing illumination of container.—2,357,417, filed Sept. 13, '43, pat. Sept. 5, '44, E. B. Marple.

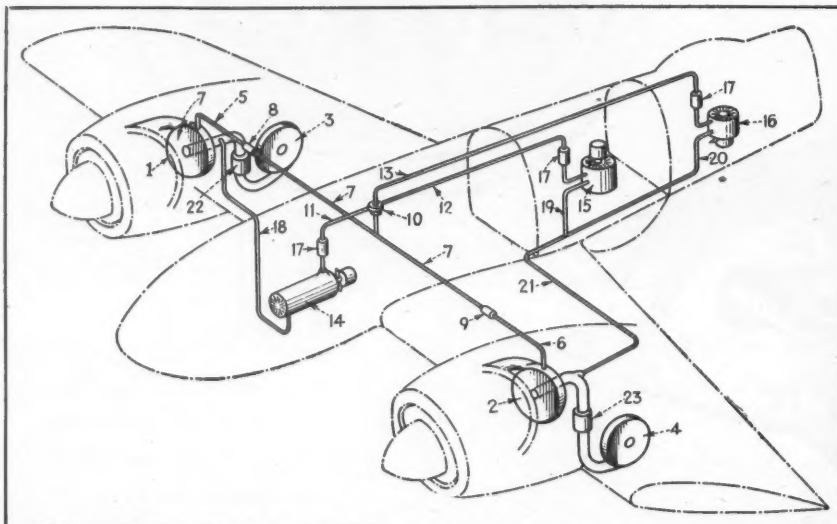
Aircraft Training Device is apparatus to give student realistic concept of flying and proper use of controls to maintain flight. Fuselage structure provided with conventional controls is mounted for responsive movement on end of beam pivoted for movement about horizontal axis and for rotation about vertical axis.—2,357,481, filed June 5, '43, pat. Sept. 5, '44, H. J. Mallon.

Airplane Bomb Hoist is wing-mounted and adaptable for loading flying boats from bomb-carrying barge. Incorporated is means for taking up cable slack, and upon increase in cable load to permit yielding to avoid shock by snubbing and stopping downward movement of bomb load, then raising bomb without jerking.—2,358,096 filed Aug. 18, '41, pat. Sept. 12, '44, G. A. Peterson, assignor to Boeing Aircraft Co.

Aviator's Seat is associated with adjacent door provided with extension to catch force of air when plane is in flight. In emergency, door is released and swings pilot clear of plane to safely use parachute.—2,358,603, filed Apr. 13, '42, pat. Sept. 19, '44, H. A. Southerland.

Fighter Plane of two-seater type has control system intended to enable rear gunner to direct craft in order to put fixed armament in rear into desired firing position.—2,358,919, filed Jan. 9, '41, pat. Sept. 26, '44, R. Fonck, vested in Alien Property Custodian.

Airplane Flight Demonstration device enables student to observe action of airstream on airfoils. Smoke generator is provided, and ducts lead smoke over airfoil.—2,358,931, filed July 4, '42, pat. Sept. 26, '44, M. H. Kahlow, assignor to G. Laughead.



Airplane Heating System is intended to distribute load of plurality of internal combustion heaters between plurality of engines but to operate all heaters from one engine if other fails. In accompanying illustration, superchargers (1) and (2) are power-driven and superchargers (3) and (4) are driven by engine exhaust. Extending from high pressure chambers of superchargers (1) and (2) are conduits (5) and (6) connected to conduit (7) through check valves (8) and (9). Conduit (7) leads to distributor (10) from which other conduits (11), (12), and (13) lead, respectively, to heaters (14), (15), and (16). Heater (14) is approximately twice size of each of heaters (15) and (16). Solenoid (17) in conduits (11), (12), and (13) is controlled by electrical circuits (not shown) for cutting heater off and on in accordance with cabin temperature requirements. Exhaust pipe (18) from heater (14) connects with intake of supercharger (1) at point posterior to discharge from supercharger (3). Exhaust pipes (19) and (20) from heaters (15) and (16) discharge into pipe (21) connected with intake of supercharger (2) at point posterior to discharge of supercharger (4). Turbo-carburetors (22) and (23) are included, respectively, between high pressure sides of superchargers (3) and (4) and low pressure sides of (1) and (2).

Utilization of power-driven and exhaust-driven superchargers gives comparatively uniform pressure maintained in conduit between them at point where exhaust from heater enters supercharger conduit.

If engine stops, pressure in corresponding conduit (5) or (6) will drop to that of atmosphere at plane altitude, and pressure in other conduit will deliver larger amount of carbureted air than when both engines were operating, but flow through distributor (10) will remain substantially constant. All heaters continue to operate, although the one having exhaust connected to operative engine will receive slightly less combustible mixture than previously received and other heater (or heaters) will receive same or slightly more mixture.—2,357,112, filed Apr. 2, '43, pat. Aug. 29, '44, S. E. Heymann, assignor to Stewart-Warner Corp.

Book Reviews

A GUIDE TO NAVAL STRATEGY, by Bernard Brodie. Princeton University Press, Princeton, N. J. 314 pages, index. $2.75.

Treatment is given in this book (which is a revised edition of the earlier "A Layman's Guide to Naval Strategy,") to the role of the air arm in modern sea power.

SYMPOSIUM OF THE APPLICATIONS OF SYNTHETIC RUBBERS. American Society for Testing Materials, Philadelphia, Pa. 145 pages. $1.50.

Consists of 13 technical papers presented at the Spring 1944 meeting of the ASTM in Cincinnati, each written by an authority in the field.

THE COMING AIR AGE, by Reginald M. Cleveland and Leslie E. Neville. Whittlesey House, McGraw-Hill Book Co., N. Y. C. 359 pages, photos. $2.75.

An over-all and closely written survey of problems of postwar aviation, with practical emphasis on what can and cannot be done in private and commercial aviation, in light of our present knowledge. Treatment includes discussions on postwar technical and financial status of industry, geography of the air, freedom of the air, airlines, and sky freighting. Aspects of typical plane structures in relation to practicality come in for consideration, also of more speculative type

(Turn to page 300)

PAYLOAD IS PEOPLE OR PACKAGES

A most cursory study of the Constellation's performance records indicates immediately that it can never be considered a one-job transport. *Versatility* is the word. Interiorwise, for instance, the Constellation is easily adapted to meet the commercial demand of the specific route, to carry its payload in terms of people or packages or both. Flightwise, it is able to operate most economically over the specific distance required—whether transcontinentally *or on flights as short as 100 miles.* Indeed, versatility is the word. Express, sleeper or inter-city local, the Constellation is designed to solve *special* problems of the individual airline.

The Lockheed Constellation

SETS THESE NEW WORLD STANDARDS

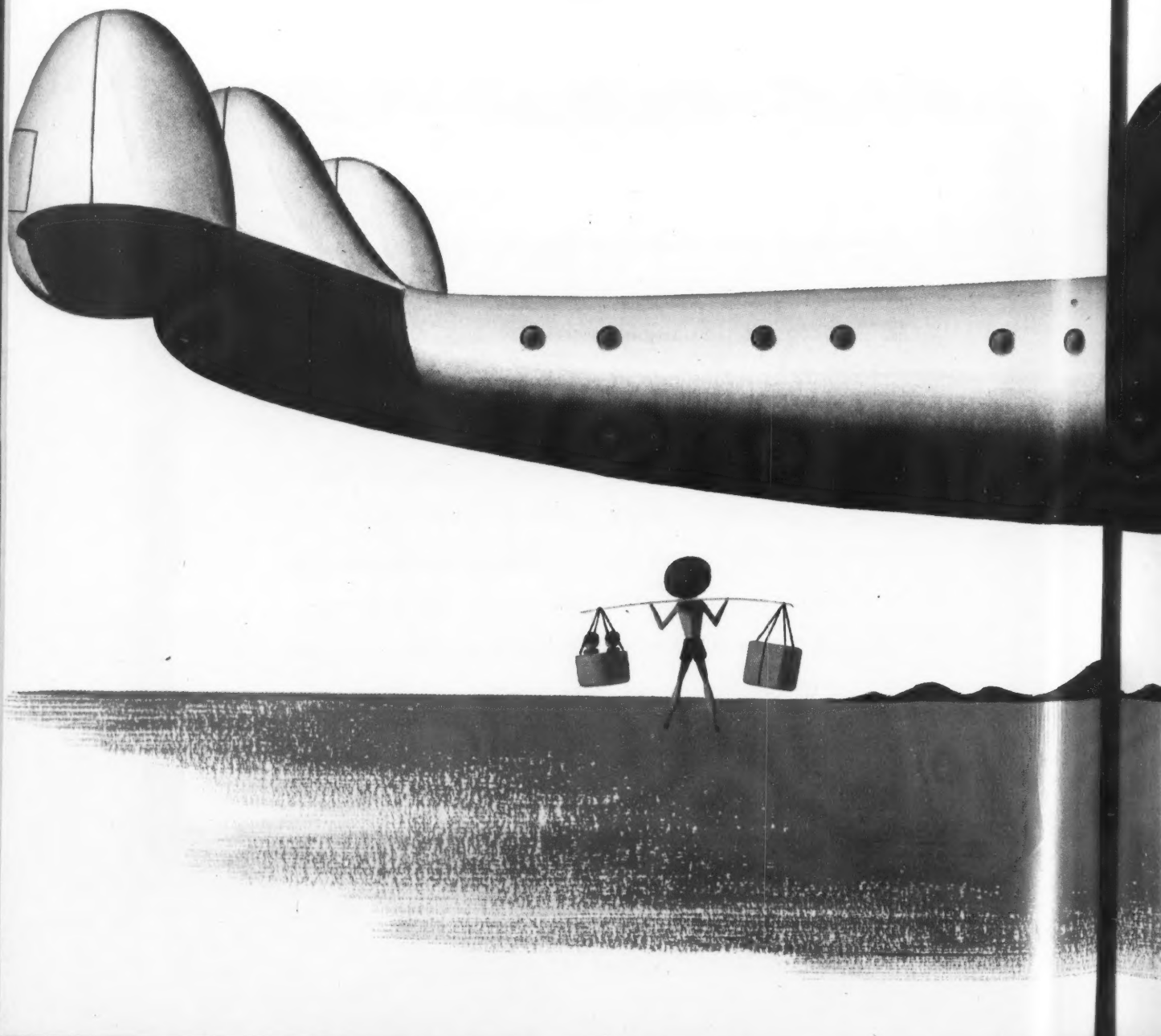
Biggest load-carrying capacity of any transport

Longest range of any transport ☆ Fastest speed of any transport

Greatest rate of climb of any transport ☆ Highest cruising altitude of any transport

And these performances make the Constellation

the *safest* of any transport



Leadership

IN LOAD-CARRYING CAPACITY

Lockheed's Constellation is a big plane—big enough, in fact, to carry 64 passengers and their baggage. In addition, it has adequate space for mail, express and cargo. Two compartments totaling nearly 500 cubic feet are available and may be loaded and unloaded underneath the plane. Revenue loads of approximately 18,000 pounds can be carried easily by the Constellation on medium-distance operations.

QUESTIONS

Q. Are oxygen masks ever necessary when flying in the Constellation? –M. G., Maplewood, N. J.

A. *No. Constellation passengers never go above 8,000 feet even if the plane's altitude is as high as 20,000 feet. Automatic devices control density, heat, purity and circulation of air in passenger compartment.*

Q. Why does it take so long to develop a new transport? –John T., Baton Rouge, La.

A. *In addition to hundreds of thousands of man-hours of basic engineering, literally thousands of tests are made in the wind tunnel before an airplane is built. On the Constellation, a complete hydraulic system, duplicating the entire functional mechanism of the airplane, was constructed and tested for months to assure perfection of all parts.*

Q. Is there a reason for the sharklike profile of the Constellation fuselage? –Tom P., Los Angeles, Calif.

A. *Yes. Its airfoil design allows maximum length for full-round pressurized cabin. Down-sloping nose camber gives better pilot visibility—reduces landing gear weight.*

Q. You say the Constellation is a safe airplane. Why? –R. L., Springfield, Mass.

A. *In the first place four powerful engines mean greater safety. The Constellation will CLIMB on any two of them, land or take off fully loaded with a very short run, and is able to fly over bad weather. In addition to its great power there are scores of other safety features. A few of them are: tricycle landing gear, automatic fire extinguishers and power boosts on operating controls.*

Send in your questions . . . Address: Lockheed Aircraft Corporation, Department 69-55, Burbank, California

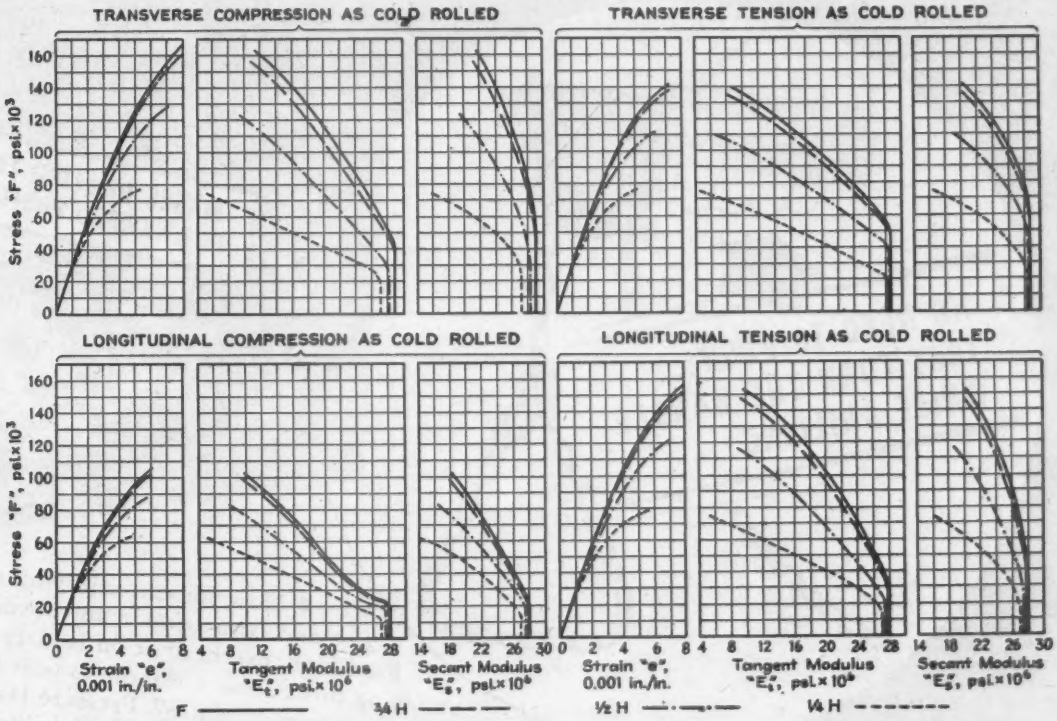
LOCKHEED

FOR NEW WORLD STANDARDS IN AIR TRANSPORTATION
LOOK TO *Lockheed* FOR LEADERSHIP

Lockheed Aircraft Corporation, Burbank, California

Elastic Properties Stainless Steel Sheets

• Armco High Tensile Stainless Steels meet the tensile requirements of specifications AN-QQ-S-772a, given below, have compressive and tensile properties at least as high as those tablulated on these and preceding pages. Working stresses can be obtained by dividing by proper factor of safety.


TRANSVERSE COMPRESSION AS COLD ROLLED
TRANSVERSE TENSION AS COLD ROLLED
LONGITUDINAL COMPRESSION AS COLD ROLLED
LONGITUDINAL TENSION AS COLD ROLLED
Stress "F", psi x 10³
Strain "e", 0.001 in./in.
Tangent Modulus "Et", psi x 10⁶
Secant Modulus "Es", psi x 10⁶
F
¾ H
½ H
¼ H

Bending Properties — AN-QQ-S-772A

Test specimens must withstand cold bending in any direction relative to rolling direction through angle indicated in following table and on a diameter equal to N times thickness of specimen without cracking.

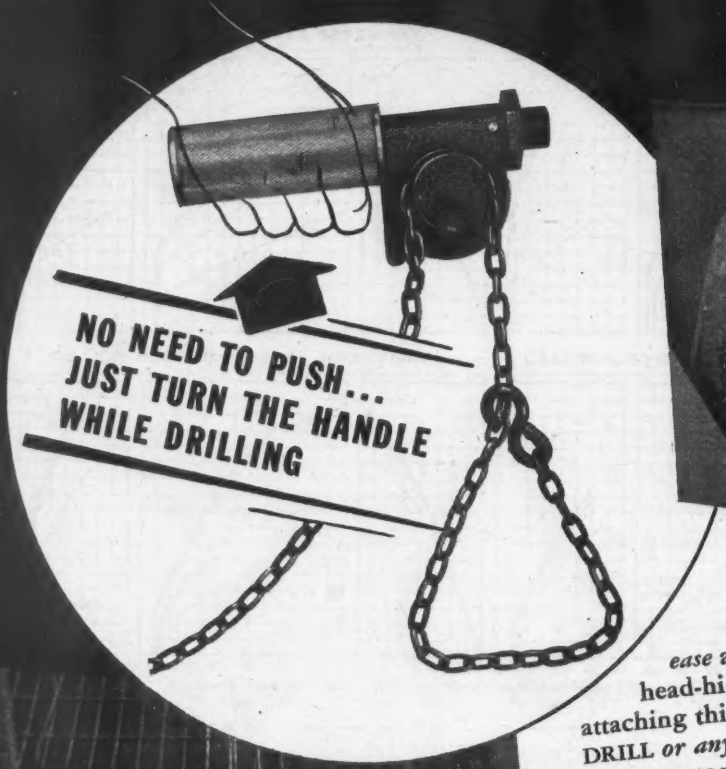
Composition and Physical Condition	Thickness 0.030 In. and Under		Thickness 0.030 to 0.050 In.		Thickness 0.050 In. and Over	
	Angle in Deg.	N	Angle in Deg.	N	Angle in Deg.	N
Class I & II						
Annealed	180	1	180	1	180	1
¼ Hard	180	1	180	1	90	2
½ Hard	180	2	180	2	90	2
¾ Hard	180	3	90	2½	—	—
Hard	180	4	90	3	—	—

Physical Properties

Class and Physical Condition	Tensile Strength Lb. Per Sq. In.		Yield Strength At 0.2% Set Lb. Per Sq. In.	Elongation in 2 In. (Min.) Thickness Up to 0.015 In.	Thickness 0.016 to 0.030 In.	Thickness 0.031 In. And Over
Class I (Low Ductility)	Min.	Max.	Min.	Percent	Percent	Percent
Annealed	75,000–100,000		30,000*	40	40	40
¼ Hard	125,000	——	75,000	12	12	12
½ Hard	150,000	——	110,000	7	8	8
¾ Hard	175,000	——	135,000	3	5	7
Hard	185,000	——	140,000	3	4	4
Class II (High Ductility)						
Annealed	75,000–100,000		30,000*	40	40	40
¼ Hard	125,000	——	75,000	25	25	25
½ Hard	150,000	——	110,000	15	18	18
¾ Hard	175,000	——	135,000	10	12	12
Hard	185,000	——	140,000	8	9	9

* Value of yield strength for information only. Yield strength tests will not be conducted unless specified.

MAKE ANY DRILLING JOB in any position EASIER with this *Pressure Handle* on a SKILSAW DRILL!



• Now you can drill with *extra ease* and *extra safety* in any position . . . head-high, overhead or on ladders . . . by simply attaching this Pressure Handle to your SKILSAW DRILL *or any make of drill.* Pressure Handle gives the operator complete control of drilling pressure at all times . . . eliminates twist drill breakage . . . saves the time of an extra man with ropes or chains to hold the drill.

Fits SKILSAW DRILL Models "64", "80", "82", "83", "101", "103", "121", "123", "141", "143", and all other makes of electric or pneumatic drills of from ⅜ in. to 1 in. capacity in steel.

Sold Nationally Through Skilsaw Distributors for $30.

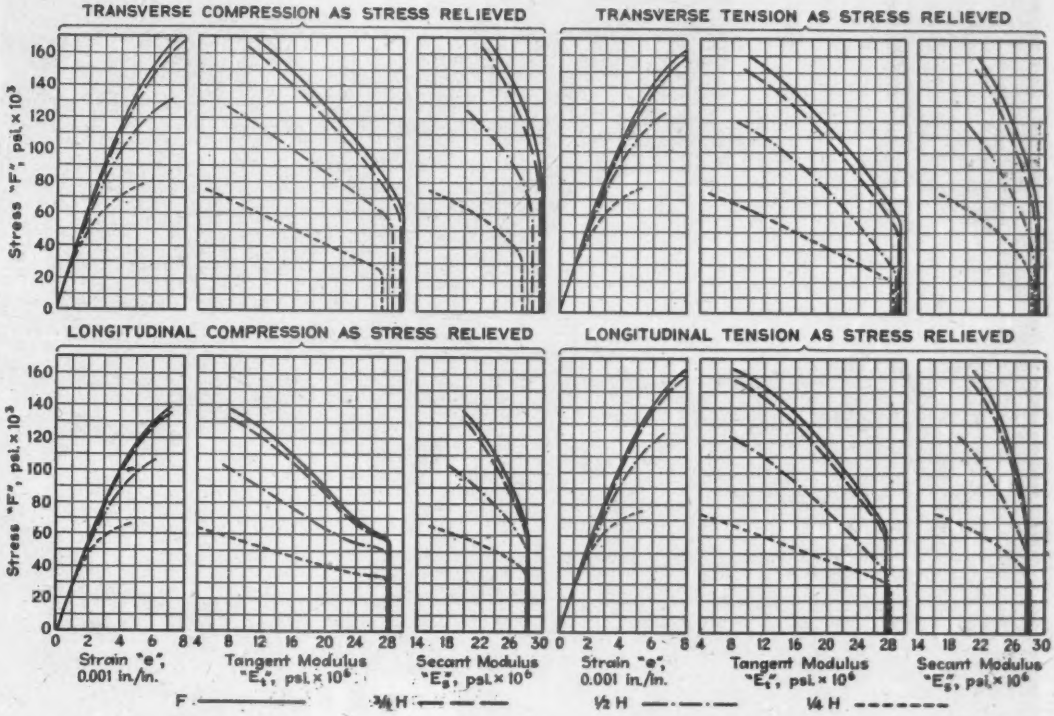
Ask your distributor today for a demonstration of this Pressure Handle on your own work.

SKILSAW, INC.
5033-43 Elston Avenue, Chicago 30, Ill.

Sales and Service Branches in All Principal Cities

SKILSAW PORTABLE ELECTRIC TOOLS
MAKE AMERICA'S HANDS MORE PRODUCTIVE

Elastic Properties Stainless Steel Sheets


TRANSVERSE COMPRESSION AS STRESS RELIEVED
TRANSVERSE TENSION AS STRESS RELIEVED
LONGITUDINAL COMPRESSION AS STRESS RELIEVED
LONGITUDINAL TENSION AS STRESS RELIEVED
Stress "F", psi. x 10³
Strain "e", 0.001 in./in.
Tangent Modulus "Et", psi. x 10⁶
Secant Modulus "Es", psi. x 10⁶
F
¾ H
½ H
¼ H

		Transverse Tension as Cold Rolled				Transverse Tension as Stress Relieved			
		¼ Hard	½ Hard	¾ Hard	Full Hard	¼ Hard	½ Hard	¾ Hard	Full Hard
Ultimate strength—psi. x 10³	F_{tu}	135	164	185	189	135	162	182	185
Yield strength at 0.2% offset— psi. x 10³	F_{ty}	75	110	135	140	75	121	153	160
Proportional limit at 0.01% offset— psi. x 10³	F_{tp}	40	63	80	84	38	52	63	66
Initial modulus of elasticity—psi. x 10⁶	E_o	28.5	28.5	28.5	28.5	28.5	29.0	29.0	29.0
Elongation—percent in 2 in.		38	30	25	23	58	36	20	17
		Transverse Compression as Cold Rolled				Transverse Compression as Stress Relieved			
Ultimate buckling strength—psi. x 10³	F_{cu}	95	150	190	198	95	150	190	198
Yield strength at 0.2 offset—psi. x 10³	F_{cy}	75	123	156	163	75	127	165	173
Proportional limit at 0.01% offset— psi. x 10³	F_{cp}	42	60	73	75	40	72	95	100
Initial modulus of elasticity—psi. x 10⁶	E_c	27.0	28.5	29.0	29.0	27.5	29.0	30.0	30.0
		Longitudinal Compression as Cold Rolled				Longitudinal Compression as Stress Relieved			
Ultimate buckling strength—psi. x 10³	F_{cu}	95	134	163	168	95	138	169	175
Yield strength at 0.2% offset—psi. x 10³	F_{cy}	62	83	99	102	66	104	132	137
Proportional Limit at 0.01% offset— psi. x 10³	F_{cp}	27	31	34	35	44	59	70	72
Initial modulus of elasticity—psi. x 10⁶	E_c	27.0	28.0	28.0	28.0	28.0	28.0	28.5	28.5
		Longitudinal Tension as Cold Rolled				Longitudinal Tension as Stress Relieved			
Ultimate strength—psi. x 10³	F_{tu}	133	162	183	187	133	159	178	183
Yield strength at 0.2% offset—psi. x 10³	F_{ty}	75	117	147	153	75	123	157	164
Proportional limit at 0.01% offset— psi. x 10³	F_{tp}	35	49	59	61	44	65	80	84
Initial modulus of elasticity—psi. x 10⁶	E_c	27.0	27.5	28.0	28.0	28.0	28.0	28.0	28.0
Elongation—percent in 2 in.		46	37	31	29	52	39	29	27

(Courtesy American Rolling Mill Co.)

Manufacturer wishes following deleted on p. 209, Nov. AVIATION: Under "Temper" delete figures 125, 150, 175, 185 opposite Ultimate Strength; 75, 110, 135, 140, opposite Yield Strength; 25, 18, 12, 9 opposite Percent Elongation. Note that Yield Strength was taken at 0.01% offset and Proportional Limit at 0.2% offset.

Our Christmas Wish....

That this World be producing for Peace

ere Christmas comes once more.

★ **AIRCRAFT MECHANICS** INC.

COLORADO SPRINGS, COLORADO

▲▲▲ DESIGNERS ▲▲▲ ENGINEERS ▲▲▲ MANUFACTURERS ▲▲▲

The AVIATION NEWS

BLAINE STUBBLEFIELD, Washington HERB POWELL, New York

Plan New Expansion of Airborne Operations With Aircraft "Built Around" Equipment

. . . Move to settle terms of field program . . . Wright shapes CAA for postwar . . . More comments sought re CAR changes . . . Status of civil instructors, reservists reported . . . Report WTS settlements . . . Zone flying still tight . . . Begin 4th IAT program.

Army is preparing to expand airborne operations on a big scale. Fully 90 percent of the equipment, weapons, and supplies used by the Ground Forces is already transportable by air. The other 10 percent will be made air transportable by (1) modification of the equipment, and (2) increasing the capacity of carrier aircraft.

Many military authorities believe that airborne attacks will be carried out on an army-size scale in this war if it continues for many more months. Only a few divisions have been sent by air, fully equipped, to their objectives thus far. The Germans conquered Crete with lightly equipped troops in chutes, gliders, and fly-in planes. The U. S. Army flew an infantry battalion from Australia to New Guinea, 1,400 mi. over the Owen Stanley Mountains, and followed up with 2,000,000 lb. of supplies per week.

Similar operations were carried out in Burma, Sicily, Normandy, and most recently in Holland, where 5,292 airplanes took part with 2,602 gliders in putting down three divisions of troops with 4595 tons of freight.

Troop Carrier Command officials, interviewed at TCC headquarters, Stout Field, Ind., and at the airborne war display on Washington National Airport in early November, told AVIATION that the new Fairchild C-82 cargo carrier, which grosses about 50,000 lb., is just a beginning. They are planning still bigger aircraft, to fly the largest bulldozers, heavy guns, and medium tanks. Some of these planes will have to be "designed around the equipment" they are to carry.

The Army's researchers are finding ways to reduce the weight of everything, from trucks to portable kitchens and first aid stations and evacuation equipment. They are changing the design of vehicles, weapons, and tools, for rapid loading and unloading.

It is easy to find Army men in high authority who believe that main armies—men, weapons, and supplies—will take to the air, and that military walking and driving will diminish to minor proportions.

To whatever extent the Army goes aloft, by so much the over-all requirement for airplanes will be increased, probably with no diminution in tactical and strategic types. Heavy fighter protection is requisite for daylight airborne attack.

A major shift to the air would change not only the logistics of war, but also the strategy. The element of surprise nears perfection in airborne operations. Without any sign of intention, a command of any size can rendezvous at night, and hit an objective in any direction, at several hundred miles range. And range will constantly increase.

Move to Settle Terms Of Airfield Program

With expansion of private aviation depending heavily upon development of an extensive airparks and airports program, CAA and other interested groups are trying to settle the terms under which expected appropriations by Congress will be allocated among states and municipal and county governments.

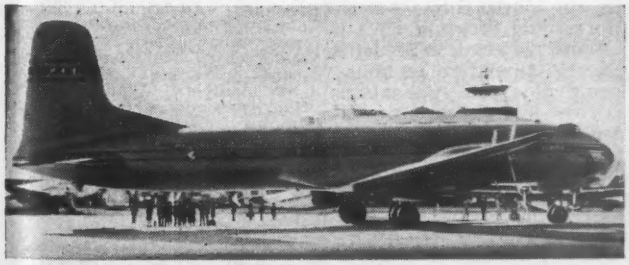
CAA's report to Congress recommending its airport program was held up by the Bureau of the Budget while the Bureau was considering other things, including a report from the Public Works Administration which also concerned airport requirements. Like the Bureau of Public Roads, which bid to participate in a flight strip program, PWA may try to play a part in airport planning.

It is hoped that Congress will act, early next year, on a bill by Rep. Jennings Randolph, or a similar measure, authorizing expenditure of $1,000,000,000 in 10 yr. as federal aid to local airport projects, mostly small fields for private and non-scheduled commercial aviation. CAA is proposing a master airport plan which parallels the Randolph bill.

The big cities, represented in Washington by powerful lobbies, want federal airport funds allocated directly to them, not to the States, which, they fear would spend too much of it on smaller municipalities. Congress will be strongly influenced by whatever agreements may be reached prior to action on the bill.

Wright Shapes CAA For Postwar

In order that CAA may meet additional responsibilities—in administration of American flag participation in the postwar world airline system, in an unprecedented domestic transport expansion, in the



TRY THIS ONE FOR SIZE

Scale model—and mighty realistic, too—of Douglas DC-7, super transport ordered by Pan American for postwar international lines. Panam's order for 26 totals over $40,000,000, or $1,500,000-plus for each plane. Carrying 108 passengers and crew of 13, DC-7 will cruise at over 300 mph. and have maximum range of 5,000 mi. Although details have not been released, craft is said to be seven times larger than DC-3, with wingspan "equal to height of 16-story building."

Coming Up

Dec. 4-6: SAE National Air Cargo Meeting, Hotel Knickbocker, Chicago.

Dec. 5-7: Aviation Distributors & Manufacturers Assn., Second Annual Meeting; National Aviation Trades Assn., Annual Convention; and Aviation Writers Assn. Board of Governors Meeting, Hotel Jefferson, St. Louis, Mo.

Dec. 11: ASME Industrial Conservation, Aviation & War Production Divisions, Joint Meeting, Engineering Societies' Building, 29 W. 39th St., N. Y. C.

Dec. 12-13: First California Aviation Conference, Hollywood Roosevelt Hotel, Hollywood, Calif.

Dec. 13: Canadian Aircraft Traffic Managers Meeting, Montreal.

Dec. 17: IAS Wright Brothers Lecture, U. S. Chamber of Commerce Auditorium, Washington.

Jan. 8-12: SAE Annual Meeting & Engineering Display, Book-Cadillac Hotel, Detroit.

Jan. 30-Feb. 1: IAS Thirteenth Annual Meeting, N. Y. C.

Apr. 4-6: SAE National Aeronautic Meeting, Hotel New Yorker, N. Y. C.

Apr. 10-14: ACCA Airplane Technical Committee (10-11) and National Airworthiness Requirements Committee (13-14), New Orleans.

Apr. (date to be announced): IAS Spring Meeting, Detroit.

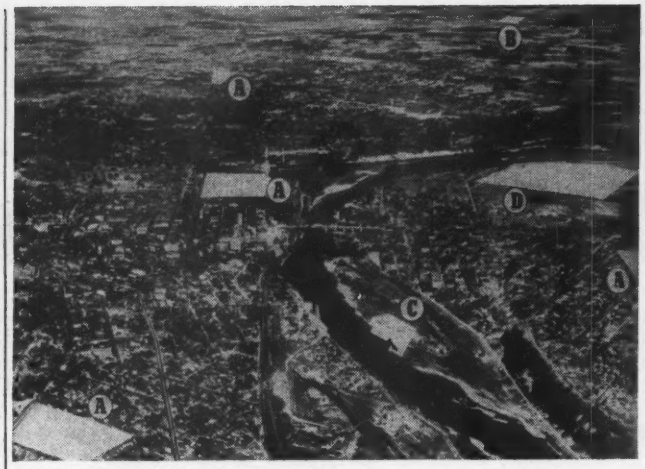
May 16-17: SAE National Diesel Fuels & Lubricants Meeting, Hotel Carter, Cleveland.

May 20-27: Pan-American Aircraft Exposition, Dallas, Tex.

June 4-6: SAE National War Material Meeting, Book-Cadillac Hotel, Detroit.

promising but difficult personal and non-scheduled aviation development, and in maintaining this country's leadership in both operations and manufacturing of aircraft—T. P. Wright has made some new arrangements in the Civil Aeronautics Administration, of which he recently became Administrator.

Major operations services: Federal Airways, Safety Regulations, Standardization Center, Washington Airport, and Regional Administration, all remain under the direction of Charles Stanton, Deputy Administrator. Foreign Operations are placed in charge of Al S. Koch, Assistant Administrator. Bruce Uthus is director of the various phases of training, including that of foreign nationals, and continuation of the civil pilot training program, authorized by Congress. The over-all rearrangement divides CAA into three main services: Administrative, Operations, and Development.



ONE FOR EVERY NEED

Here's how Aero Chamber would locate landing facilities for all types of flying in one of nation's larger communities. Dubbed in on actual photo are: (A) airparks for personal flyers; (B) flightstop, or intermediate landing area between cities; (C) air harbor, for water-fitted craft; and (D) airport for scheduled air transport operations. (Wide World photo)

More Comments Sought Re CAR Changes

Vastly important to individual flyers and to the entire private flying group is the new CAB revision of Civil Air Regulations governing the certification of pilots and aircraft.

The Board recently mailed out a proposed draft of amendments for comment and suggestions by many interested persons and organizations. Probably the strongest and most revolutionary proposal received by CAB was from Joseph T. Geuting, chairman of the Personal Aircraft Council of the Aero Chamber. The Council's proposal, in a nutshell, was that regulations of pilot certification be reduced to the enforceable minimum, and that a lot of "musts" be replaced by "shoulds."

Pilots' certificates should be relatively as easy to get as drivers' licenses, the Council has contended. Likewise, it wants aircraft manufacturers' responsibility for design and production placed on a level comparable with that of the automobile industry, the idea being that builders of airplanes want them to be safe just as much as the government does.

But many persons in government, and some in aviation and in aircraft production, do not want the certification of pilots and planes to have so much leeway. They think that an irresponsible person in an airplane is a greater menace than he is in an automobile, and they contend that if manufacturers were free to build planes as they wish, they would skimp on materials and workmanship, with the result that conscientious competitors would be hurt, and that the reputation of aviation in the public eye would suffer.

At this writing CAB was about ready to send out a second draft of its revised regulations for comment by many persons and groups. Officials said they had given serious consideration to the Council's proposals, and to those from other sources. The forthcoming circular offers the last chance to those who wish to make suggestions. Probably the final revision will not become law till some time next year.

Status of Civil Instructors, Reservists Reported

AAF has completed interviews with 10,314 civilian flight instructors, 7,303 of whom had become unemployed as a result of training curtailment early this year. And now a statement issued by the War Department explains that fewer than half of the total unemployed expressed a desire to enter any phase of AAF flying training.

A total of 1,394 enlisted reservists asked to be discharged and 2,762 non-reservists chose to remain civilians, subject to selective service. Reservists now employed by the airlines total 341, and 220 are working as civilians for the Air Transport Command. The remaining 2,586 are disposed in various AAF training categories. Of the 10,314, about 3,000 are still employed in primary contract schools. It was the unemployment of these large numbers of skilled pilots that finally forced the liquidation of the WASP—Women's Airforce Service Pilots.

The War Department emphatically warns, however, that men in, committed to, or eligible for, military training are subject to changes in the war's trend, and points out that transport pilot training will cease Dec. 31, and that no service pilot applicants have been accepted since Sept. 30.

Report WTS Settlements

CAA's War Contracts Termination Board has been settling War Training Service contracts at the rate of one a day. L. W. Lawrence, chairman of the Board, has worked out a settlement procedure which, his announcement says, is satisfactory to 75 contractors who had been settled with late in October. These 75 had entered claims for $3,500,000, which were settled for $1,600,000.

Begin 4th IAT Program

In its fourth Inter-American Training Program, CAA is receiving 128 aviation students from 19 American republics. Closing date for applications was Nov. 15. The group is divided as follows: 19 pilots, 37 mechanics, 35 technicians, and 37 internees for on-the-job connections with U. S. aviation.

Zone Flying Still Tight

That statement about "designated landing areas" for point-to-point flying on the West Coast does not mean that the usual restrictions are off of private flying. Flyers still are not permitted to go from outside the Zone to airports within the Zone, or vice versa. In other words, no unchecked flying is permitted on the Pacific Coast.

On the East Coast, where enemy activity is considered much less likely, the Army seemed about to lift the ban at this writing, but was being cautious about it.

★ SPOT CHECKING ★

Nationwide survey by Bendix Aviation shows that 307 out of 455 colleges and universities replying plan to give postwar aviation courses, but most all said they would need government-owned aircraft. Responses showed 237 colleges now teach some phase of aviation, 212 of which will continue or expand curricula, and 95 out of 140 not now teaching aviation are planning to establish air courses.

Illinois' newly adopted rulings and regulations of its Aeronautics Commission, promulgated after two public hearings, is said to eliminate headache of duplicate authority, since interstate operations are left up to CAA. Outside Chicago, all airports are licensed by the state.

Institute of Aeronautical Sciences is recipient of gifts totaling $164,800 made by Convair, Rohr Aircraft Corp., Solar Aircraft Corp., Ryan Aeronautical Co., Langley Corp., and individuals. Funds will be used to provide facilities at airports to advance aeronautical science.

Brig. Gen. Orval R. Cook heads up Procurement Division of ATSC, new streamlined set-up combining functions of buying and supervising production of aircraft for AAF.

Piper has issued new profusely illustrated promotional booklet titled "How to Fly a Piper Cub," aimed at "encouraging as many airminded people as possible to begin taking flight instruction."

Also in the promotional field: MacGregor - Goldsmith, Cincinnati sports-equipment manufacturer, is distributing 36-page amateurs' flying manual, prepared by Reginald M. Cleveland.

Three new civil air attaches have been ordered abroad by State Department. They are: Ogden Pierrot, Lisbon and Madrid; Holard B. Railey, Paris; and Charles M. Howell, Jr., Rio de Janeiro.

Brochure of Miami Aviation Country Club, presently being formed, shows plans of proposed homes which could be built adjacent to landing field by resident members. Plans include private hangar as integral part of house.

★ CANADIAN NOTES ★

By James Montagnes

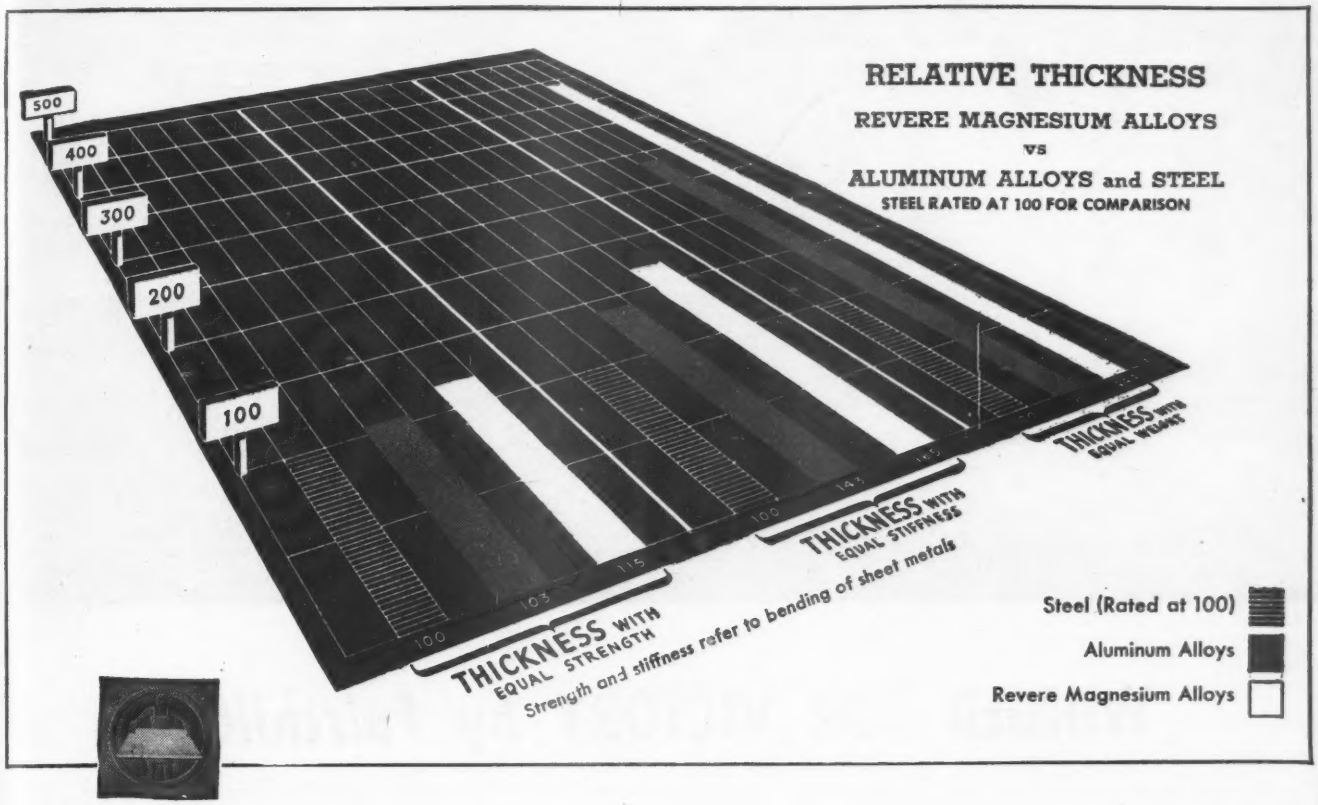
Record flight between Montreal and Natal, Brazil, was made late in October by RAF Transport Command when converted Consolidated Liberator flown by Captain Paul Zimmerman, a Canadian, covered the 5,600 mi. in 26 hr. 52 min.

Canada has signed a 99-yr. lease on Goose Bay Airport, Labrador. Lease covers only military operations. Port is currently used

MAGNESIUM'S MODERN MATHEMATICS

+15% −74% = 100%

Revere Magnesium Alloys



IF you have a product whose weight you would like to cut drastically without sacrificing strength or rigidity, consider the simple mathematics of magnesium. Suppose it is a tank you are concerned about, a tank for oil or gasoline on a truck, a plane, or on some other equipment where weight-saving would be important.

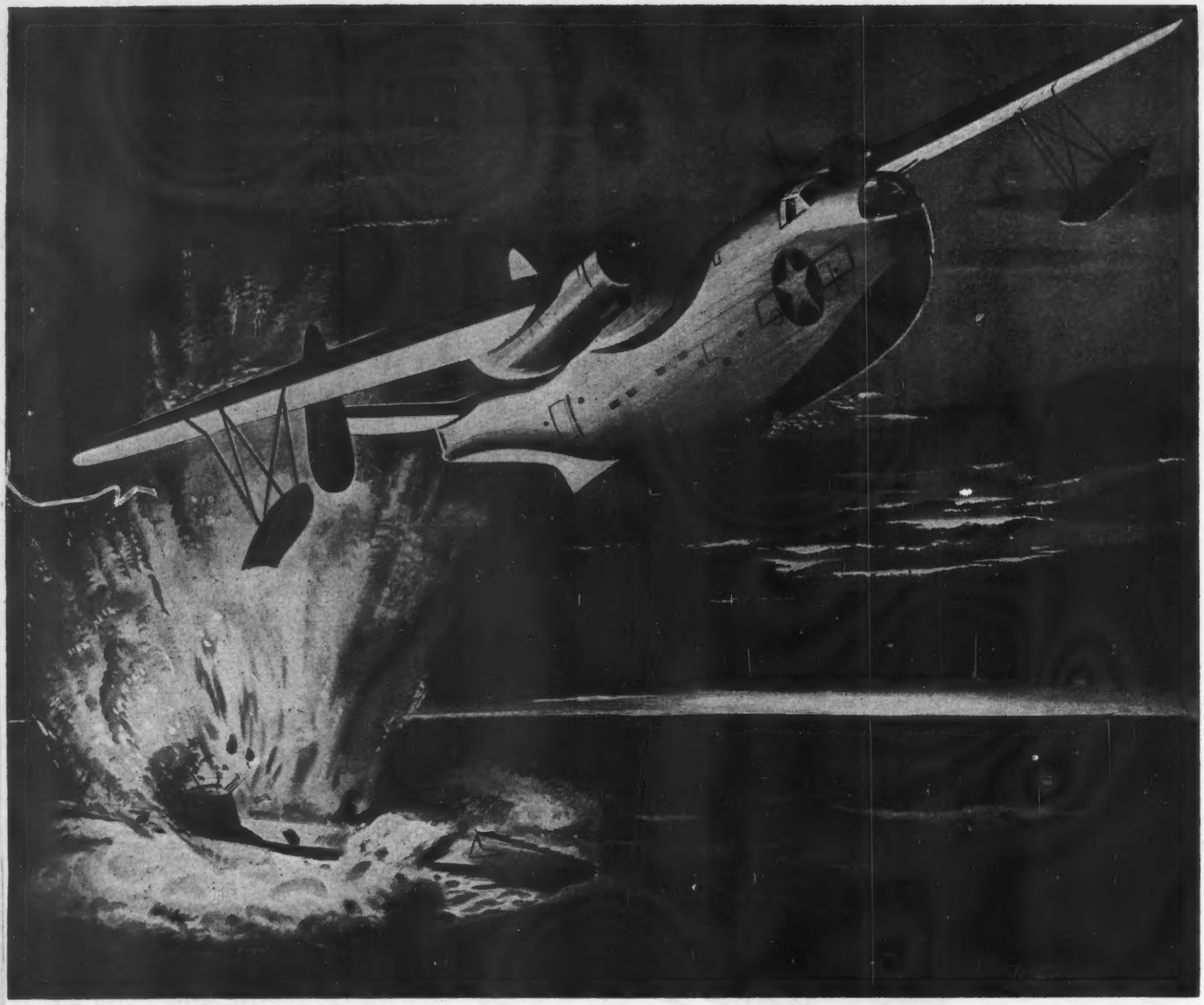
Such a tank, if made of Revere Magnesium Alloys, would be 74% lighter than one made of steel. Its walls would be only 15% thicker and they would be as strong as steel. Stiffness equal to steel would require walls only 65% thicker, and you would still have a tank 63% lighter than steel. You can have equal or greater strength and stiffness and still save weight.

Remember that adoption of Revere Magnesium Alloys means economy, not only to the user of the finished product because of light weight, but marked economy to you in handling, manufacturing and shipping. The Revere Technical Advisory Service will aid you in realizing those savings.

Send for your complimentary copy of the new 32-page booklet, "Revere Magnesium Alloys and the Light Metals Era."

REVERE

COPPER AND BRASS INCORPORATED
MAGNESIUM-ALUMINUM DIVISION
Founded by Paul Revere in 1801
Executive Offices: 230 Park Avenue, New York 17, N.Y.



WINGED FOR VICTORY *by Fairchild*

On wings built by Fairchild, the Navy's big patrol bombers—Martin PBM-3 Mariners—fly to war over the seven seas.

They've sent many a submarine to the bottom. They soar by the hundred over icy arctic waters; patrol the far reaches of the Pacific; carry bombs and munitions, cargo and men to combat on distant naval fronts.

Behind their constantly increasing numbers is the story of industrial America at war—the story of American vision, enterprise, initiative and cooperation combining to accomplish the "impossible".

Three years ago there was a critical need for these big flying boats. Fairchild undertook the job of building the vital wing panels despite the fact that Fairchild had just launched a heavy production schedule, building famous Cornell primary trainers for the Army Air Forces, and manufacturing other Fairchild-designed aircraft.

In this day of industrial miracles, this Fairchild accomplishment stands as another example of the job that can be done with cooperation, technical knowledge and production skill.

BUY U. S. WAR BONDS AND STAMPS

Fairchild Aircraft

Division of Fairchild Engine & Airplane Corporation, Hagerstown, Maryland....Burlington, North Carolina

by British, United States, and Canadian air forces, operator being RCAF.

In what was claimed as an aviation first, an autogiro at Baker field, Toronto, recently towed a glider on short flights.

Plans to build 300 airstrips throughout Canada at municipalities with populations over 2,000, were outlined recently by Russell L. Gibson, president of Cub Aircraft of Canada, Ltd., Hamilton, Ont. Called for are strips up to 3,000-ft. long and 200-ft. wide.

Victory Aircraft, Toronto, has now turned out its first York, transport version of Lancaster.

Munitions & Supply Minister C. D. Howe has now been appointed Minister of Reconstruction, a new government department. Meanwhile, he continues administration of Dominion civil aviation.

RCAF has stopped recruiting, and 4,200 aircrew trainees have been released. "First-in first out" is policy of discharges. About a third of the RCAF is expected to take part in the war against Japan, with transfer to Pacific theater being on voluntary basis.

Ralph P. Bell, director-general of aircraft production for Canada, has resigned with the completion of the training aircraft production program, and the functions of the aircraft production branch of the Department of Munitions & Supply have been taken over by the government-owned Federal Aircraft, Ltd., which was established to produce Anson twin-engine bomber trainers.

Production and cost figures on aircraft produced in Canada since the start of the war have been released at Ottawa to the end of 1943. A total of 10,517 aircraft with a weight of 21,882 short tons, without their engines, was produced, and cost, with overhaul at various times, totaled $755,000,000.

By F. H. Fullerton

New Canadian company is Aero Caterers, Ltd., recently incorporated with paid-up capital of $98,000. Described as firm engaging in airport restaurant operation, company has Ontario headquarters at Canada Railway News Co., 475 Union Station, Toronto, and British Columbia headquarters with same company at National Railway Station, Vancouver.

OBITUARY

Milo Burcham, chief pilot, Lockheed Aircraft Corp. He joined Lockheed in 1937 as ferry pilot, later headed flight testing at company's Liverpool div. Subsequently, he was engaged in engineering flight testing at Burbank and was appointed chief pilot early in '44. He also developed and conducted special training course for 4th Air Force pilots.

Maj. Gen. Walter R. Weaver, retired. Graduating from West Point in 1908, he then served in various military capacities, last being as head of AAF Technical Training Command. Following his retirement shortly after inactivation of the command, he was consultant to Aviation Corp. In Dec. '43, he was awarded DSC.

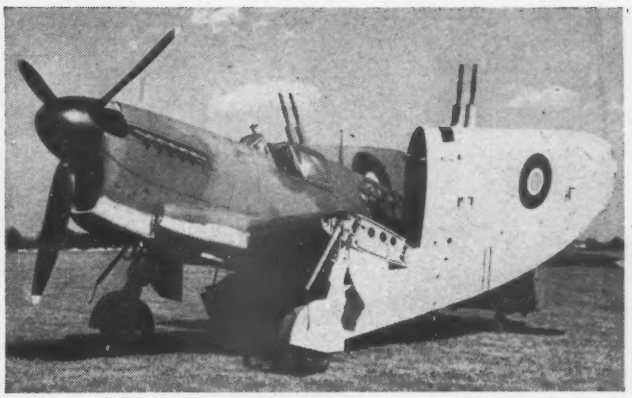
Thomas Midgley, Jr., inventor of Midgley indicator and ethyl gasoline. Graduated from Cornell in 1911 as mechanical engineer, he later was associated with C. F. Kettering in organization of General Motors Research Corp. As early as 1928 he conducted research in field of synthetic rubber. He received medals from various scientific societies.

Elmer W. Wiggins, founder and treasurer of E. W. Wiggins Airways. An engineering graduate of M.I.T., he was long associated with du Pont company and later formed Wiggins Airways. From 1942 to 1944 he operated an Army primary flight training school at Camden, Ark.

Oscar T. Ridley, superintendent of southern flight operations, American Airlines.

Sir Francis John Linnell, Air Marshal. Serving as deputy commander-in-chief of Middle East RAF, he previously had been attached to Ministry of Aircraft Production. He also served with RAF in World War I, and was knighted in 1943.

Charles E. J. Modjeski, chief of aircraft conversion for All American Aviation, Inc.



FIREFLY THAT FOLDS

Close-up of Fairey Firefly fighter-reconnaissance plane designed for carrier-based operations. Carrying crew of two, it has cameras in addition to armament of four 20-mm. cannon. Craft appears to be development of Fairey Fulmar, with principal difference lying in armament and new Rolls Royce Griffon engine. (Press Association photo)

AMERICA AT WAR

Aviation's Communique No. 36

The amount of devastation which strategic and tactical aviation is piling on enemy war works and operations is satisfactory, but the amount of it the enemy is taking while still going strong is a surprise and a disappointment to most military commanders. This deficit is more than offset, however, by the effectiveness of seaborne aviation, which now constitutes the major striking power of the Navy.

Prospects for airpower in new equipment, and new strategy and tactics, appear unlimited. Chiefly foreseen is future-war importance of air carrier craft expected to stem from such designs as the Fairchild C-82, and which will fly all of the weapons, equipment, and supplies that armies are using or plan to use, giving airborne forces new speeds and ranges. Another promising air weapon is the airborne rocket, which, when its accuracy is improved, will give aviation the hitting power of heavy artillery, with many times the speed and range. Not least is the field of concentrated fuels, now being developed, which may stretch the range and capacity of aircraft so that all war strategy and logistics can be revised to unheard-of levels.

On the German front, operations of Lt. Gen. L. H. Brereton's Allied Airborne Army are rated highly successful, indicating that more damaging inside jobs will be done on the Nazis by air troops. Air Chief Marshal Leigh-Mallory asserts the Luftwaffe is using its full power, and has nothing in reserve. Gen. H. H. Arnold, AAF Chief, believes that Allied bombing of German airplane factories has cut production to 800 units per mo. But so strong is the enemy's punch that the Allies recently lost 400 bombers and 39 fighters in one week—AAF lost 41 bombers and 28 fighters in one attack. The great AAF-RAF bombing invasions continue at 1,000-plane strength and greater, beating up war production and communications on a scale which many authorities would have judged the enemy could not endure so long.

Trend continues toward combining characteristics of dive-bomber, low level bomber, ground strafer, and fighter, in one airplane, with constant addition of striking power to such planes as the North American P-51, Lockheed P-38, Republic P-47, and with the advent of the Northrop P-61 Black Widow night fighter, and of the Douglas A-26 Invader. The new P-75 has been taken out of production because these other airplanes are giving the desired results.

Britain's Hawker Tempest fighter, successor to the Hurricane and Typhoon, knocked down more than 600 V-1 flying bombs and is now after the Nazi jet Messerschmitt 262. Incidentally, German jet planes fly and climb fast, but they do not turn well. The press reports that a P-38 photoplane outmaneuvered an Me-262. RAF announces a new faster Spitfire, changed from Merlin power to the Griffon 65, with 23 percent more cylinder displacement, and two-stage supercharging. North American Aviation is working on bomber and fighter designs expected to give performance much superior to present standards, but production could not begin for several months. Jet assisted takeoff is making good progress. Flying bombs are being improved over German practice, probably will be used by the Allies in this war, and probably will be a major weapon in future.

Important on the Pacific front is Stalin's fighting reference to Japan as an "aggressor," the inference being that Russia will jump Nippon when the time comes, or at least give the Allies the bases from which to jump. The Japs played their sea power hand for the Philippines, and lost, which means that Allied navies and armies in the Philippines will soon isolate the entire Netherlands empire and Singapore.

The greatest air fleet ever massed in the Pacific, 1,000 planes of U. S. forces, recently hit Formosa. American fleet victories at the Philippines, which dropped Japan to a third or fourth rate naval power, evidently used a preponderance of aviation to do the job, knocking off enemy battleships, lighter craft, and six airplane carriers—more than 60 ships in all.

The B-29's undoubtedly are working out of other than Chinese bases by now. Their strike on Singapore was the longest military air mission thus far. These airplanes are well beyond the reach of enemy AA fire and air attack, with resulting very light losses. They have been able to reconnoiter the Jap mainland at altitude without fighting.

Though the Japs have lost over 3,000 airplanes in four months, they probably are more than replacing losses, and the quality of their new designs approaches that of our own. As they pull their air forces out of lost positions, the resulting concentrations in

108 Series – over 3000 Sizes – a NORMA-HOFFMANN PRECISION BEARING for every load, speed and duty in aircraft service.

★

Write for the Catalog. Let our engineers work with you. Or, let one of our Field Engineers call.

NOW

The Story of

SIKORSKY HELICOPTER

(United Aircraft Corporation)

Can be Told

In 1940—an interesting but promising experiment.

In 1944—a recognized success—accepted by the U. S. Army and Navy, the U. S. Coast Guard, and the British Royal Navy—proved by actual service tests from the Arctic to the Tropics—in rescue work at sea—in transporting blood plasma—in evacuating personnel from inaccessible points.

NORMA-HOFFMANN PRECISION BEARINGS proudly participate in its achievements.

TO WIN THE WAR: WORK—FIGHT—BUY WAR SAVINGS BONDS!

NORMA-HOFFMANN BEARINGS CORP'N. STAMFORD, CONN. *Founded* 1911

Field Offices: NEW YORK • CHICAGO • CLEVELAND • CINCINNATI • PITTSBURGH • DETROIT • LOS ANGELES • SAN FRANCISCO • SEATTLE, WASH.

Japan and China will be stronger and tougher.

Accomplished and coming: A total of 46,000,000 lb. of weapons and supplies were flown over the Hump to China by ATC in one recent month. Navy is turning over some airplane carriers to the Marines, who will use Vought F4U's on their decks.

★ CALLING NAMES ★

T. **P. Wright,** CAA administrator, will give Wilbur Wright Memorial Lecture before Royal Aero Society next May.

Harry P. Kupiec, formerly with Glenn L. Martin, now heads Air Associates hydraulics div.

Joseph D. Boylan is new regional cargo director for AA with headquarters at Airlines Terminal Bldg., N. Y. C.

Edward M. Benham and **Laurens H. Fritz** are new assistants to **Norman V. Clements,** UAC director of advertising and publicity. **George E. Slye** becomes publicity rep. of P & W div., succeeding Benham.

Robert Crabb, eastern sales rep., Bendix Aviation Corp., Pacific div, has been made country-wide field engineer, with N. Hollywood as main office.

Kenneth Fletcher, formerly with Bell public relations, is now with Boston Area ATSC.

S. J. Miller, becomes PCA chief of plant maintenance.

Frank E. Ross is new asst. in Western Region office of Aircraft Manufacturer's Council and parent ACCA. He will help coordinate industry reconversion, surplus materials disposal, transition problems.

G. O. Wiggin becomes asst. gen. mgr. of ACCA to mesh activities of eight committees of Aircraft manufacturers Council and assist in management of chamber's service depts.

J. S. Farra becomes customer service manager for Douglas at general office, Santa Monica.

D. H. Robinson is named personnel manager at UAL N. Y. C. office.

H. Curtis Hardick, formerly field representative of Republic Aviation, Farmingdale, L. I., has been named gen. mgr. of D. A. Comstock & Co., So. Norwalk, Conn., maker of B-29 engine covers.

John M. Cook fills newly created position of advertising manager for NWA. **C. Wesley Archbold,** formerly of supply and service div., ATC, is named director of flight meals.

George W. Mitchell comes to CAB as tax consultant and director of special study of multiple taxation which has been ordered by Congress. He is on leave from Federal Reserve Bank, Chicago, where he serves as tax economist.

Streamlining of TWA's organizational set-up results in appointment of four new regional managers. Named are **W. F. McGrath, gen. mgr.** eastern region; **C. E. McCollum,** gen. mgr. central, Chicago; **W. N. Gorham,** gen. mgr. midwestern, Kansas City; and **J. S. Bartles,** gen. mgr. western region, Los Angeles. All functions of operations dept. are combined with field work of traffic dept. under transportation dept., which is headed by **John A. Collings,** vice-pres. of transportation.

F. T. Sterling has been made asst. manager of contracts dept. of Curtiss-Wright's St. Louis plant. New assignments in sales promotion dept. went to **G. Sumner Ireland,** eastern representative, now at Rockefeller Plaza, N. Y.; **T. D. Harvey,** southeast, at Miami; and **C. K. Travis** and **R. F. Wolford,** both at St. Louis plant.

A. N. Kemp, pres. of AA, has been elected a director of Chase National Bank.

Willis Kropp joins Aircraft Parts Development Corp., Summit, N. J., as industrial design engineer and stylist.

Col. Donald J. Keirn of ATSC power plant lab. has received Thurman H. Blane award for 1944 from Institute of Aero. Sciences for his contribution to development and utilization of new jet propulsion engine.

THE WASHINGTON WINDSOCK

By BLAINE STUBBLEFIELD

Military air transport services in the Pacific will take on importance and intensified activities as war pressure shifts to Japan. Some of the Atlantic and Southern services may be terminated earlier than others.

If the war lasts long enough you will see some new airplanes designed around tanks, field guns, bulldozers, tractors. These planes will have to carry up to 80,000 lb. in addition to fuel, crew, arms.

Rapid development of troop carrier operations put more AAF men in line to stay in the war along with walking soldiers till the last Jap surrenders.

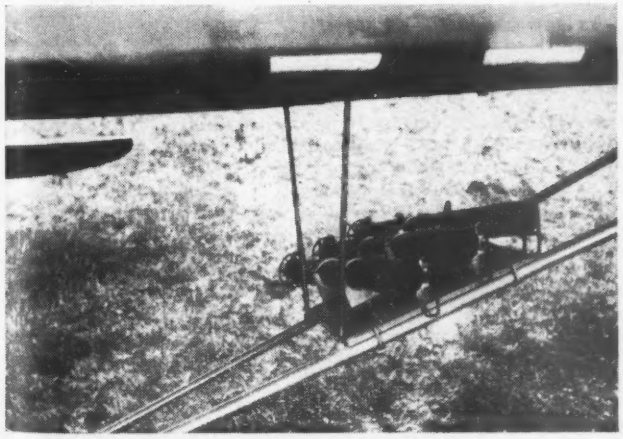
As the time approaches for renewal of battle over revision of civil air law, it becomes apparent that all who use airplanes are not brothers under the skin. Legislators and administrators may have to recognize further the need of special consideration for air transport, private flying, and other branches.

Some there were who said the Russians, as our election approached, became impressed with the possibility of Republican victory and for that reason stepped out of the international air conference; they are supposed to have thought defeat of the Administration would mean repudiation of American foreign policy.

Aeronautical oracles are already busy speculating on American representatives on the proposed international aviation commission. You can list **E. P. Warner, T. P. Wright,** and **Jerome C. Hunsaker** as good bets for the technical chair. Don't bet on the policy candidates.

Few people realize that the Navy, as now composed of swift, long-winded task forces built around airplane carriers, is a completely new kind of weapon—almost an air weapon—and that there is nothing else like it or by any means comparable to it in the world. You can go on from there with your own conclusions.

A big question in Washington is whether the public will back up Army and Navy in a strong research and development program in peacetime—that is, a program which will continue anything like the present rate of advance in air, ground, and sea warfare. Nothing could beat such a research operation, with U. S. industry standing behind it, and it would be cheap. Your best guess is that it won't be done.



WHAT, NO PARATROOPS TOO?

Army's liaison planes, mostly Cubs, have long served with top efficiency as eyes of artillery, doubling as supply and casualty evacuation planes whenever necessary—but always without armament. Now, however, they're punching on European Front as well as seeing, with batteries of three rockets mounted on wing struts. Rockets can be fired singly or in salvo. (Press Association photo)

J. E. White is named sales engineering representative of Kropp Aviation Forge Co. for northern part of Ill., with h.q. at Rockford.

James C. De Long, formerly advertising director of General Cable Corp., has been appointed director of advertising for TWA, with headquarters in Kansas City, Mo.

A. C. Streamer, vice-pres. of Westinghouse Electric & Mfg. Co., is new pres. of Nat'l. Electrical Manufacturers Assn., succeeding **Leonard Kebler,** chairman of board, Ward Leonard Electric Co.

Guy M. Springer, Jr., has been appointed airmail and cargo traffic manager with Braniff Airways. **Capt. Gordon C. Shook,** recently returned from overseas duty, has resumed his position as district traffic mgr. in San Antonio. **Jay M. Jackson** is new asst. to general counsel for company in Dallas.

Col. Kenneth R. Collins assumes command of ATSC Eastern Procurement District, with h.q. at 67 Broad St., N. Y. C.

Dave Gatch, supervisor of passenger service for CAL in Denver, becomes senior dispatch clerk in flight control office.

Aero Insurance Underwriters announced promotions and additions to staff: **Harold Montee** is now manager of Kansas City office, with **Jack H. Quick** as asst. mgr.; **Cecil Brandon** is coordinator in N. Y. home office; and **Eugene Beese** is new field underwriter in Atlanta office.

(Turn to page 228)

WPB Reports Plane Production by Types; Grand-Total Output Since 1940 is 232,403

. . . Reconversion, termination in changing perspective . . . OCS takes fourth step to speed settlements . . . 'Copter weed-out foreseen . . . Orders for airliners mount . . . Vari-pitch for light job? . . . Meeting on engine policy . . . Uniformity mission goes to Britain.

For the first time, the WPB has released warplane production in a breakdown by types. Since July, 1940: Bombers 74,963; fighters 70,627; transport 17,592; naval reconnaissance 2,345; trainers 54,642; communications 10,785; special purpose 1,459. That makes a grand total of 232,403.

Unit production in October was 7,429, a slight drop from the 7,598 acceptances in September—and a considerable drop from the all-war high of 9,118 in March. Total airframe weight, exclusive of spares, was 75,400,000 lb. in October, a drop from the 78,945,000-lb. figure of September.

The decline is due to design changes, emphasis on heavy bombers, and contract cutbacks. More, and drastic, stop orders are expected as Allied forces score new successes at the front.

Reconversion, Termination In Changing Perspective

War industry reconversion and contract termination are subjects that have to be followed almost from day to day to be understood. Congress has passed the Demobilization Act of 1944, the President has signed it, and the WPB has announced its V-E Day plans, under the law.

WPB is all set to go into reverse, from war mobilization to demobilization. But just as the war mobilization plan did not work too effectively until the war actually started, so demobilization cannot be planned down to precise details till peace comes in Europe.

The President, and many Congressmen, have been dissatisfied with the law, and Capitol Hill may make further changes. Probably there will be an aviation division of the remobilization plan.

OCS Takes Fourth Step To Speed Settlements

Termination of contracts is a matter of more concern than reconversion, so long as the war lasts, because thousands of war contracts, and many airplane contracts, are being terminated now.

The Office of Contract Settlement has now taken a fourth step to hurry termination settlements so manufacturers can get onto other war jobs or prepare for postwar work. Regulation No. 4, issued by Robert H. Hinckley, head of OCS, gives the contractor the choice either to buy government-owned equipment he is using, or have it removed within 60 days after request, except when he needs it for other war jobs.

First three regulations dealt with T-loans (termination), part payment of termination claims, and pre-termination agreements.

'Copter Weed-Out Foreseen

There seem to be more versions of the helicopter than there were of the basic airplane in early development stages, and a long weeding-out process is ahead, says Grover Loening, chairman of the helicopter subcommittee of the National Advisory Committee for Aeronautics.

This will call for a great deal of talent (not to speak of courage) and engineers who have it should be encouraged, he believes. Very rapid progress has been made, in Mr. Loening's opinion, but several very difficult problems remain to be dealt with. Vibration must be reduced; speed must be increased; control must be simplified; and production costs must be lowered.

Mr. Loening is in a position to have all inside information on helicopters. One observer recently was heard to wisecrack that a person still needs five hands and six feet to fly a helicopter.

Orders for Airliners Mount

Accumulating airline orders for postwar plane deliveries now amount to about $100,000,000. The first $50,000,000 worth of contracts were placed about two months ago by four or five airlines for Douglas DC-4 and DC-6 types.

Since then, Pan American Airways has ordered some DC-7's, and American Export is expressing interest in the DC-4's and DC-6's. National Airlines has placed orders for $3,500,000 worth of DC-4's and for 16 Curtiss-Wright C-W 20's, commercial version of the military Commando, and Eastern Air Lines is negotiating for C-W 20's also, and for DC-4's, assigning about $25,000,000 to both types. Meantime, United, which initially ordered 15 DC-4's and 20 DC-6's, has called for an additional 15 of the 6's.

Vari-Pitch for Light Jobs?

Interest is building up for variable pitch propellers in postwar light airplanes. A half dozen manufacturers have plans for producing various types of pitch-control hubs, and others will be in the field.

Diamoloy Tool Co., of New York, is producing a two-position pitch hub in large quantity for Army liaison planes. This hub, stated to weigh no more than a plain fixed-pitch unit, is reported to cost about $1.25 per horsepower. Further, Bartlett Hayward, of Baltimore, producing for the armed services, is turning out the only fully automatic hub, with no controls whatever. Cost is put at about $200 in the 65-90 hp. range, and weight at about 25 lb.

Engineers expect that these weights and prices will be greatly reduced through design shortcuts and mass production, both of which are receiving great impetus from the war. Some manufacturers contend the light planes, whose fixed propellers are pitched for highest efficiency at top cruising speed, can already take off all right because of the many available long runways.

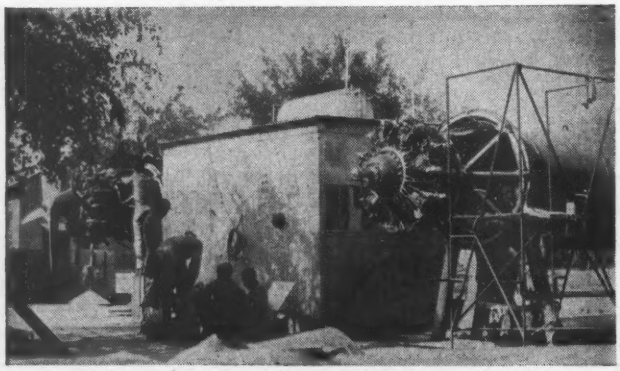
Meeting on Engine Policy

United States aircraft engine companies, comprising the Engine Technical Committee of the Aero Chamber, recently met with military officials in Washington to discuss clarification and interpretation of military service policies governing the design, procurement, and development of aircraft engines; determination of the contractors' responsibility under the varying provisions of changing technical requirements; and the importance of eliminating separate service requirements wherever possible. This meeting was called by the Aeronautical Board of the joint chief of staff of Army and Navy.

Uniformity Mission in Britain

Aircraft industry technicians are in England studying aircraft standard parts, practices, and materials in an effort to bring about uniformity for the American and British aircraft industries.

The mission was organized and is conducted by Flight Lieut. D. G. Moffitt, RAF, of the British Air Commission, and members represent the National Aircraft Standards Committee and the Society of Automotive Engineers. They are returning a visit made to the United States by a British technical mission in May, 1943.



'NEATH SHADE OF OLD OLIVE TREE

AAF unit in North Africa uses portable engine test stands and cell developed by Jacobson & Co. Two engines may be checked up simultaneously, and sound-proofed test house has equipment set-ups similar to those used in permanent installations.

★ ASSEMBLY LINES ★

Order for 1,000 more B-29 Superfortresses has been received by Boeing Aircraft Co., Seattle.

New Manual on contract termination has been issued by Jack & Heintz for use of its vendors and subcontractors.

Cutbacks in steel landing mat orders exceeding $20,000,000 and extending through Mar., '45, is announced by WPB. Twenty-one plants will be affected.

Hamilton Standard Propellers Div. of United Aircraft Corp. has announced Pawtucket, R. I., plant will be closed at end of this year.

Report containing composite picture of aircraft industry con-

servation program is result of further survey by Operating Committee on Aircraft Materials Conservation, in response to requests by aircraft contractors. Copies may be obtained from committee, Room 1029 Navy Bldg., Wash., 25, D. C.

Over 1,000,000 hp. is represented in engines and power sections built in October at Kansas City plant of Pratt & Whitney Aircraft Corp. of Missouri.

The 5,000th Cyclone 18 has been produced at Wright Aeronautical Corp.'s Wood-Ridge, N. J., plant, in operation 22 months. Also first of 16 new test cells, able to accommodate engines up to 4,000 hp., was opened at this plant for testing 2,200-hp. Cyclone's for Boeing B-29's. Further, company's Lockland (Cincinnati) plant has completed 50,000th 14-cyl. Cyclone.

Thirty Chinese engineers will receive year's training in production work and specialized occupations at Lycoming Div. of Aviation Corp., Williamsport, Pa., under agreement providing for licensing for manufacture, assembly, and sale, in China, of Lycoming engines and parts.

Jet propulsion units are to be produced by Allison Div. of General Motors Corp., shortly after beginning of new year, in cooperation with ATSC and the General Electric Co. New facilities called for include 17 specially designed test cells, which with tools and other items is covered by Defense Plant Corp. commitment for $12,500,000.

All North American P-51 service orders are now being filled by North American's Dallas plant.

Since Pearl Harbor, more than 75,000 radio compasses have been delivered to Allied forces by Bendix Radio Div. Recent peak month's production was more than 5,000 units.

Buick Div. of General Motors has completed 60,000th P & W Twin Wasp engine. New company schedule laid down by AAF provides for two new engines—one for Liberator bomber, other for C-54 Douglas transport.

For 30-month period ending Sept. 30, '44, over 51,000 P & W engines were produced by Chevrolet Motor Div. of General Motors Corp. And meanwhile Chevrolet-Anderson plant, Anderson, Ind., has commenced production of forged aluminum alloy cylinder heads for new R-2800-C 18-cyl. P & W engines used on Republic P-47's and Northrop P-61's.

Construction under Convair's new $25,000,000 Navy Liberator contract is to begin about May, '45, after completion of present commitments.

Contract for 2,000 additional troop-carrying gliders has been awarded by AAF to Ford. Manufacture will be at Iron Mountain, Mich., plant. Company reports it has produced over 52,000 turbosuperchargers, also says total man-hours per unit were reduced from approximately 619 (first month) to 149.

To Ryan Aeronautical Co. has gone additional $40,000,000 Navy contract for undisclosed-type fighter planes designated to play important role in stepped-up Pacific war. Company states that these craft are already in production. New order brings company backlog to over $70,000,000 with the $18,000,000 in contracts received earlier for these same planes and with another $15,000,000 having been booked for exhaust manifold systems and aircraft assemblies for other companies.

Wright Field continues its experimentation with American-duplicated robombs of V-1 type. Jack & Heintz worked out direction control for our robot, Ford made impulse engines, Republic has supplied airframes and assemblies, and Monsanto Chemical Co. produced catapulting rockets to send bombs into air.

Ford announces passing of 6,000 mark in output of Consolidated B-24 Liberators from Willow Run plant. And at River Rouge plant, 100,000 aluminum-stampings—bomber parts—were recently turned out in one month. "Automotive type" process employs powerful presses. Metal was once considered too soft for draw-die treatment, but problem was solved by use of lubricating oil at critical draw points in forming process.

Completion of a total of 25,000 military and naval aircraft since Pearl Harbor was announced by Consolidated Vultee late last month. This amount was figured to be 11 percent by number and 16 percent by weight of all aircraft produced in the U. S. in that period. In addition, spare parts were delivered estimated to amount to more than 4,000 equivalent aircraft.

Minneapolis-Honeywell reports it has turned out its 30,000th electronic automatic pilot for use in bombing aircraft.

★ FOR THE RECORD ★

Kollsman Instrument Div. of Square D Co. announces appointment of Inter City Aviation, East Boston, Mass., and Northwest Air Service, Seattle, Wash., and Fairbanks, Alaska, as additional distributors for postwar sales of company's instruments.

Northwest Airlines has appointed Newell-Emmett Co., N. Y. C., to handle company's advertising account.

G. M. Giannini & Co., 161 E. California St., Pasadena 5, Calif. has taken over manufacture of instruments for Autoflight Corp., Burbank, Calif.

General Electric Co. announces purchase of site in Anaheim, Calif., for postwar plant to manufacture airplane plastic parts.

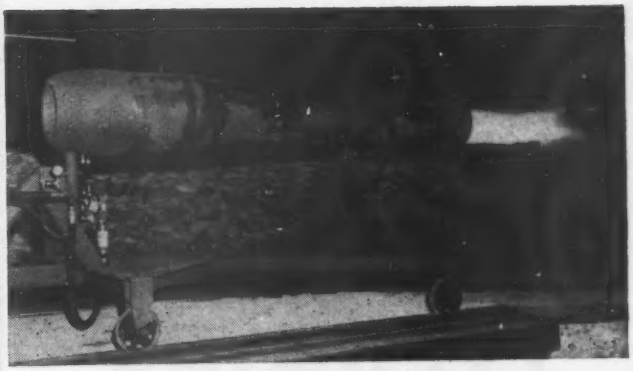
Tru-Punch Co., precision transfer punch supplier, formerly of Scotch Plains, N. J., is now located at Roseville Station, Newark 7, N. J.

Cutler-Hammer, Inc., Milwaukee, Wis., has opened sales office at 108 N. Main St., South Bend, Ind., with T. Fisher in charge.

Wickwire Spencer Steel Co.'s general sales offices of Spring & Formed Wire Div. and of Automotive Div. are now located at New Bond St., Worcester, Mass. District sales office for these divisions will continue at 500 Fifth Ave., N. Y. C., 18.

U. S. Plywood Corp. has purchased building at 941 Behan St., Pittsburgh, Pa., for use as a distribution warehouse, with H. W. Cole as manager.

American Society of Tool Engineers has established national office in Penobscot Bldg., Detroit 26, Mich. New Headquarters will house editorial staff for preparation of Tool Engineer's Handbook, scheduled for publication in 1946.



GOING NAZIS ONE BETTER

Impulse jet engine, for powering American-made robot bomb, being tested at Ford plant. Using parts of shot-down buzz bomb, Ford engineers cooperated with ATSC power plant technicians to come up, in very short time, with this Yank version said to be superior in many respects to original German model.

Sheldon Machine Co., Chicago, builder of precision lathes and arbor presses, has now acquired Vernon line of machine tools formerly built and sold by Machinery Mfg. Co., Los Angeles. Manufacture of these tools has been transferred to Sheldon's Chicago plant.

Tocco Div., Ohio Crankshaft Co., Cleveland, has completed new high-frequency induction experimental lab having 24 test heating stations supplied by 2,000 kw., with frequency range varying from 960 to 1,000,000 cycles.

Young Radiator Co., designers and manufacturers of heating, cooling, and air conditioning products, announces appointment of Rodgers Engineering Co., Dallas, as sales and engineering representative in northeast and north-central Texas.

Adel Precision Products Corp. plans to open new sales offices in Chicago, Atlanta, and Dallas.

Chicago-Latrobe Twist Drill Works has opened branch warehouse and sales office at 2043 Santa Fe Ave., Los Angeles. In charge is J. C. Malugen.

Missouri Aviation Corp. has been named agent for distribution of government excess hardware, parts, and special accessories. An estimated 35 to 50 carloads of surplus materials will be handled through company warehouse at 416 Admiral Blvd., Kansas City, Mo.

Aviation consultant offices have been opened at 475 Pasadena Way, Pasadena, Calif., by Albert Clark Reed.

Brooks Equipment Corp., N. Y. C., announces it has opened Chicago office at 1 N. La Salle St., under direction of J. K. Grindle. Company makes hand-operated remote controls used in aviation industry.

Minnesota Mining & Mfg. Co., St. Paul, has acquired Mid-States Gummed Paper Co. of Chicago.

Kent Studios Service, New York City, is entering industrial design field to handle postwar conversion plans.

Pepman Manufacturing Co. has been formed at Cleveland for the purpose of "manufacturing aircraft and other parts." Dale E. Mansperger is president.

Robinson Aviation, Inc., of New York City, announces opening of a West Coast division in Hollywood, Calif. E. S. Titus has been transferred from the N. Y. C. office to become manager of the new division. His duties will include sales and service work.

Bodine Electric Co., Chicago, has broken ground for a two-story addition to its facilities for making fractional hp. motors. It is estimated that capacity will thus be increased 50 percent.

DeVilbiss has moved its Cincinnati district sales headquarters to larger premises at 410 American Bldg., Central Parkway and Walnut St.

★ KNOW-HOWS ★

Instrument for continuous daylight measurement and recording of cloud ceilings has been developed by General Electric Co. and U. S. Weather Bureau. Reflecting 120-cycle pulsating beam from clouds to "Ceilometer" 1,000 ft. away, device enables consistently accurate recordings to be made automatically.

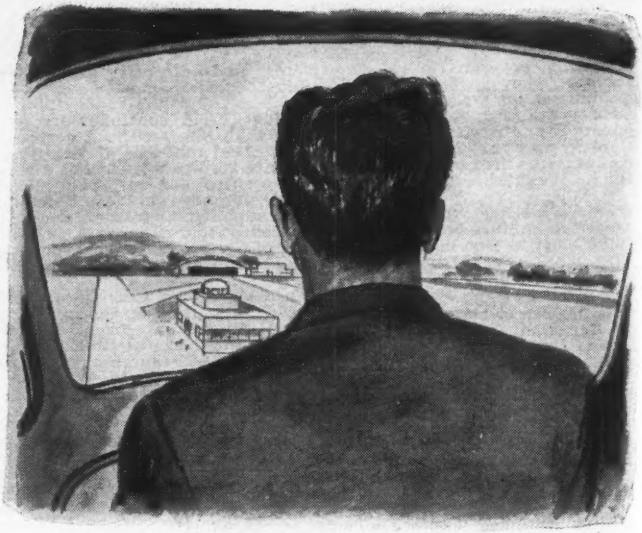
Utilizing new method, Pittsburgh Plate Glass Co.'s research division, Creighton, Pa., has produced specially clear plate glass for use in aircraft camera windows. Thickness tolerance is within .003 in. per in., with variation in millionths per in. Photographs made through this glass from 6 mi. elevation clearly define railroad ties on ground.

For hidden rivet inspection, a ⅝ in. o. d. rivetscope, 110-in. long, containing 20 lenses, has been developed by Lenox Instrument Co. and Glenn L. Martin inspection department.

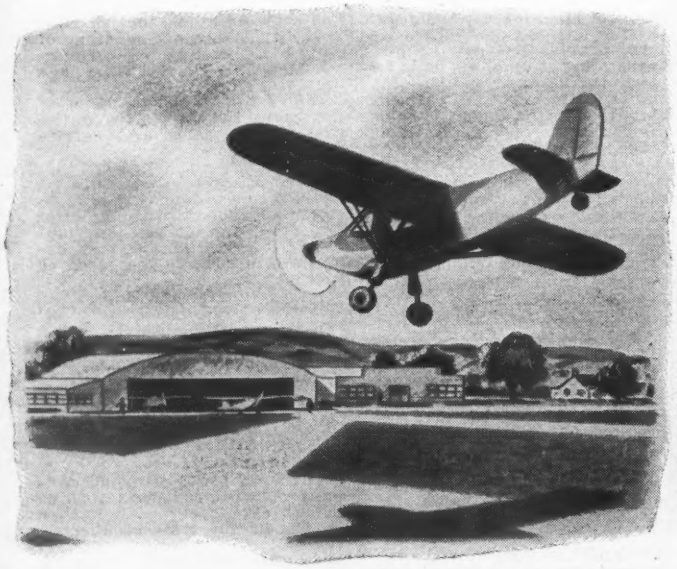
Boeing is supplying its hundreds of B-29 subcontractors with production templates made by photographing patterns onto sensitized steel sheets, then developing and fixing image using standard photographic methods. Boeing uses about 750,000 sq.ft. of these photo templates a year to serve as jigs, fixtures, patterns, and in producing dies.

General Motors has produced a simple device which accurately and rapidly measures critical thickness after machining of highly stressed airplane parts. It has been initially used in inspection of hollow steel propeller blades.

When you've got to pull out of a glide... you can count on your LYCOMING



"Coming in to land. All set for altitude and direction. Throttle back and glide."

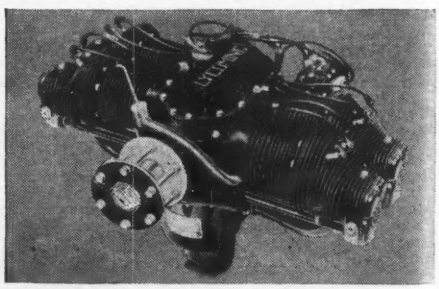


"Nose down. Pick your spot. Glide. Whoa! Overshot . . . Give her the gun!"

"Feel that Lycoming catch hold! Right on the trigger . . . cleared that obstacle like a bird."

AT no time is it more vitally important that your engine function correctly than when you give it full throttle after a glide. Then you *must have power and have it fast and without fail.*

And Lycoming fuel distribution is specially designed to give it to you. Here's why. The center zone induction system, immersed in a perpetual bath of hot oil, provides better vaporization of the fuel and uniform distribution to all the cylinders.



LYCOMING, MODEL O-145, developing 65 h.p. at 2550 rpm.

Weight — only 165 lbs., *7-10% less than competitive engines.*

Gas consumption — 2½-3 gals. per hour, *19-32% saving over competitive engines.*

Among aircraft "*Powered by Lycoming*" are: Aeronca, Beechcraft, Bellanca, Boeing, Cessna, Curtiss, Luscombe, Piper, Spartan, Stinson, Taylorcraft, Vultee.

Let Lycoming power *your* aircraft.

LYCOMING

AIRCRAFT ENGINES . . . 55-300 H.P.

AN AVCO PRODUCT

Lycoming Division
The Aviation Corporation
Dept. D-3, Williamsport, Pa.

POWERED BY LYCOMING—THE ENGINE WITH A PROVEN PAST AND A SURE FUTURE

Air Problems Smoothed at Chicago Parley; Growing Favor Shown for American Plan

. . . Hearings on North Atlantic applications completed . . . Priority passengers, cargo authorized on ATC, NATS . . . Sea airlines seen creating much new traffic . . . Factors in Panagra petition for entry into U. S.

After a discouragingly slow start, the International Civil Aviation Conference at Chicago last month made what was considered excellent progress toward laying the foundation for a workable world air policy.

Major accomplishment was the ironing out of principal differences between Anglo-Canadian and American delegates, with former originally proposing world authority with regulatory powers over routes, schedule frequencies, and rates, and latter, with wide backing, insisting on free competition under organization restricted to advisory, consultative, and technical work (also see pages 115 and 119).

At press time there was every indication the American plan would be that which delegates would take home to their respective governments.

Russia's non-participation disappointed most officials and observers, who pointed out that the Soviet, being one of the three great powers and having vast commercial resources and need for external airlines, must have consideration and reservations even though absent. Others, however, maintained that being a large, self-contained country she may not have need for, or time to start, extensive external airlines for some years. They also pointed out that neither Britain nor the U. S. need traverse Russian soil to reach major objectives.

Russia's geographical position is aeronautically unique; her airlines could reach into China, many Asiatic and European countries, and the U. S. through bilateral agreements.

Hearings on North Atlantic Applications Completed

Most important of the Civil Aeronautics Board's consolidated hearings on oversea applications—those covering the North Atlantic group—were completed last month. Hearings on the Hawaiian and Latin American groups of applications, both characterized by strong claims from steamship companies, have also been completed. But opinions and orders are not expected for some weeks or even months.

Eleven airline applications were checked in the Atlantic group, varying widely in their proposed European terminals and intermediate stops. Probably those that follow to some extent the pattern laid down in CAB's own American flag system will get favorable consideration, other things being equal. Several East Coast cities, especially New York, entered special pleas of qualification as transocean-line terminals. Possibility of early peace in Europe puts pressure on the Board to hurry its decisions.

Sea Airlines Seen Creating Much New Traffic

Estimates by both government and airlines on postwar trans-Atlantic passenger traffic have been criticized on the ground they are based on prewar steamship figures. Dr. E. P. Warner, CAB vice chairman, addressing the American Merchant Marine Council, opined that much air business will be created by the characteristics of air service, rather than be diverted from surface carriers.

Dr. Warner also said that he anticipates a very large increase in international air travel; that it will be primarily, but not exclusively, passenger business; and that air cargo will increase ten times prewar volume on routes that already had good air service, with correspondingly high figures where no such service existed, but that even then, air cargo will remain a tiny fraction of merchant marine traffic.

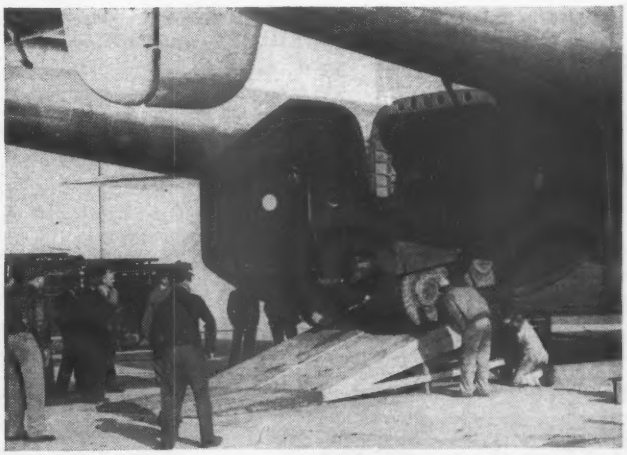
Factors in Panagra Petition For Entry Into U. S.

Pan American-Grace Airways has presented to CAB a plan to expand its services between the Canal Zone and Argentina, together with an application for an extension of its routes from Balboa, C. Z., to New York. This application culminates a long struggle with Pan American Airways (which owns half of Panagra stock) for the right to petition for entry into the United States.

Panagra called upon the President for special consideration of its claims, saying that foreign companies are already taking root in Latin America, where the Germans were forced out. The company therefore requests that it be allowed to expand, also asks that no other operators be certificated in Latin America.

Priority Passengers, Cargo Authorized on ATC, NATS

To bridge whatever gap may develop in overseas services, President Roosevelt has issued a formal order authorizing ATC and NATS to carry priority passengers and cargo for an indefinite period. Military transport has been handling civilian priority traffic in a small way all along; the Executive Order simply makes official what was requested by CAB. The military services have agreed to stop carrying commercial traffic as soon as the airlines are ready to take it.



OPEN SESAME

Capaciousness of Fairchild C-82 Packet's interior—promising good postwar cargo potential—is clearly shown by size of formidable weapon rolling down ramp, between twin booms and under stabilizer. Broad tail doors open laterally to give access to full width and height of compartment. Note smaller doors, within big ones, by which paratroopers or supplies can be unloaded in flight without danger of striking empennage.

★ BASES & COURSES ★

Complete flying service for personal planes has been announced by Southeastern Air Service, Atlanta, Ga., with opening of a major operating base at Athens, Ga., airport. Company also expects to open an approved flying school at Athens in cooperation with University of Georgia.

An aviation ground school course has been announced by University of Calif., covering CAP regulations, avigation problems, and a review of essential math.

Partial easing of restrictions on sale of aeronautical charts has been lifted as Coast & Geodetic Survey begins sale of charts to certified pilots, approved flying schools, and others who meet requirements.

★ CROSS COUNTRY ★

Plans for Chicago Municipal Airport's new $1,200,000 terminal building, to be built jointly by eight airlines serving city, are expected to be completed early in 1945. Construction would begin with assurance of priorities on materials.

"Civilian dress" Curtiss-Wright Commando, to be used by EAL and NA on N. Y.-Florida runs, was recently exhibited. Powered by 2,200 hp. Cyclones, ship will carry at least 36 passengers at 235-242 mph. speed.

Navy contracts with PAA and AEA for trans-Atlantic flights are being cancelled, effective Dec. 31, due to foreseen reduction in demand for air transport to European theater, according to announcement by Vice Adm. A. W. Fitch, deputy chief of naval operations for air.

Full life insurance coverage without extra cost is now being made available to air passengers anywhere in world by Conn. General Life Insurance Co. Pilots and crew members likewise will get company coverage.

Nevada Pacific Airlines, Inc., has received Nevada Public Service Commission's permission to operate three air routes within state.

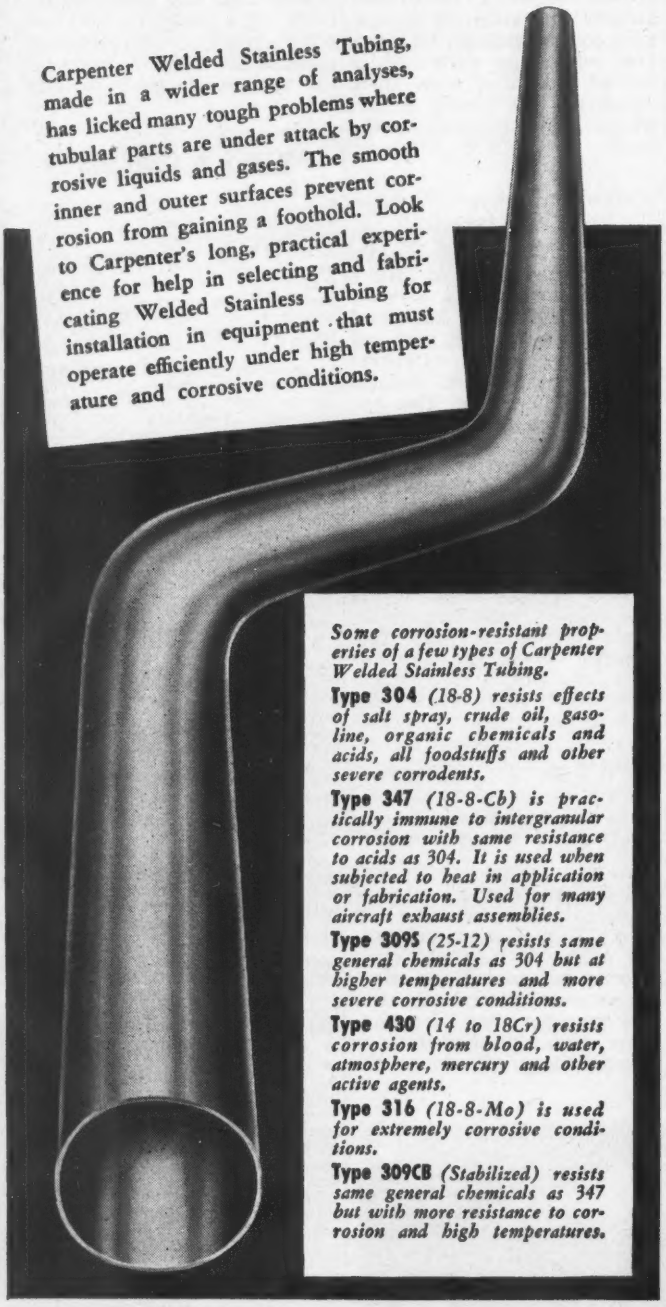
UAL announces signing of contract with Texas Co. for approximately 500,000 gal. of oil yearly.

PCA announces new ticket reservations control system in Detroit downtown terminal. Method operates on "assembly line" basis, with staff of seven operating around a circular counter and key chief reservationist in center. It can handle 500 phone calls an hour and care for 2,000 people daily, states company.

N. Y. luxury goods merchants took all space available on first AA air freighter to leave La Guardia Field. The company's freight rates are 30c a ton-mile. Among merchandise was shoes,

Which Tubing for that Corrosion Problem

Carpenter Welded Stainless Tubing, made in a wider range of analyses, has licked many tough problems where tubular parts are under attack by corrosive liquids and gases. The smooth inner and outer surfaces prevent corrosion from gaining a foothold. Look to Carpenter's long, practical experience for help in selecting and fabricating Welded Stainless Tubing for installation in equipment that must operate efficiently under high temperature and corrosive conditions.



Some corrosion-resistant properties of a few types of Carpenter Welded Stainless Tubing.

Type 304 *(18-8) resists effects of salt spray, crude oil, gasoline, organic chemicals and acids, all foodstuffs and other severe corrodents.*

Type 347 *(18-8-Cb) is practically immune to intergranular corrosion with same resistance to acids as 304. It is used when subjected to heat in application or fabrication. Used for many aircraft exhaust assemblies.*

Type 309S *(25-12) resists same general chemicals as 304 but at higher temperatures and more severe corrosive conditions.*

Type 430 *(14 to 18Cr) resists corrosion from blood, water, atmosphere, mercury and other active agents.*

Type 316 *(18-8-Mo) is used for extremely corrosive conditions.*

Type 309CB *(Stabilized) resists same general chemicals as 347 but with more resistance to corrosion and high temperatures.*

More Complete Data is contained in this file folder — factors that will help you in your selection of Welded Stainless Tubing to meet the requirements of your particular job. A note on your company letterhead will bring it to you.

THE CARPENTER STEEL CO.
Welded Alloy Tube Division • Kenilworth, N. J.

Carpenter
WELDED
STAINLESS TUBING

cosmetics, clothing, and various fabrics.

Sept. flight operations: PCA had increase of 122 percent in passengers carried over same period last year; Braniff had a 66 percent increase; and NWA reached new high with 20,766 revenue passengers carried. PCA carried 459,088 lb. of mail; Braniff, 510,879 lb. Hawaiian Airlines had 23.8 percent increase in air freight and express poundage carried over previous-month figure. PCA express jumped 7 percent; Braniff's, 24 percent.

Re postwar ocean fares: AA plans N. Y.-London charge of $235 one way, giving 10 percent discount on round trips. Sleeper flights would be $25 extra . . . PCA meanwhile quotes planned "floor price" of $176 for run from New York City to London, likewise with 10 percent discount for round trips. And sleeper rate would entail "up" of about 1c per mile . . . Further, Panam's program calls for four postwar flights daily to Bermuda at $75 for round trip.

Westchester County, N. Y., has received four bids ranging up to $60,000 yearly for use of its federal-built airport at Purchase (just north of N. Y. C.).

UAL proposes to industry plan for simplified inter-line ticket comprising flight coupons, auditor's stub, clearing house record, and passenger's receipt, all stapled together in form of book. Using carbons, agent need only fill out one stub which would take about one-fifth time now required.

Delta Air Lines is issuing to patrons booklet, "Welcome to Southern Skies," describing company's history, territory covered, war work, and postwar plans.

Michigan Board of Aeronautics has appropriated $80,000 to make a survey as basis of aviation planning in southeastern part of state. Detroit Metropolitan Aviation Planning Authority, formed of State Board and city and county officials of Detroit, Wayne, Oakland, and Macomb counties, has been formed to make the special analysis planned.

Aircraft manned by American pilots operating into Brazilian airports used extensively by American planes will now be controlled by CAA tower personnel.

Panagra is distributing, through accredited travel agents, a new trade survey of South America aimed at organizations representing American business who have personnel and means to probe possibilities of postwar markets there.

Commerce Department's Transportation Unit survey sets postwar cargo potentials between U. S. and ten South American republics at over $60,000,000 per year.

★ CALLING NAMES ★

(*Continued from page* 223)

Herbert J. Lyall, eastern traffic mgr. of AA., is now president of Airlines Terminal, Inc., N. Y. C., while **D. A. O'Connor,** northern div. mgr., EAL, is new vice-pres.

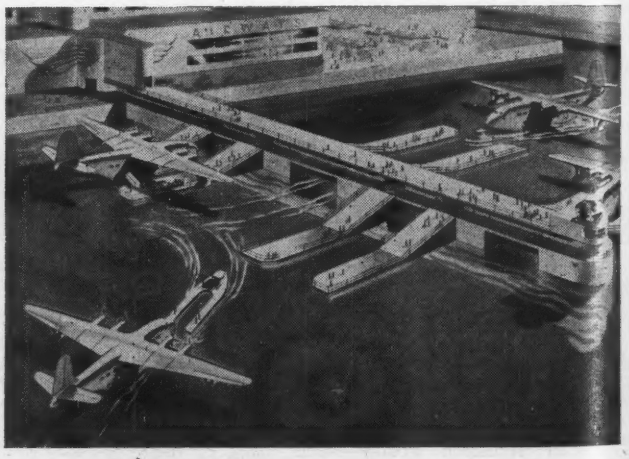
Quentin R. Cudney is named new asst. chief of flight of Consairway as service prepares for 50 percent expansion of Pacific flight operations.

Bert Zimmerly, head of Idaho's Zimmerly Air Transport service, has been named president of newly incorporated Empire Airlines.

John W. Vale, Jr., formerly with Lockheed as airline maintenance analyst and earlier with TWA as crew chief and director of training, has been named director of training of Aero Industries Technical Institute, Los Angeles.

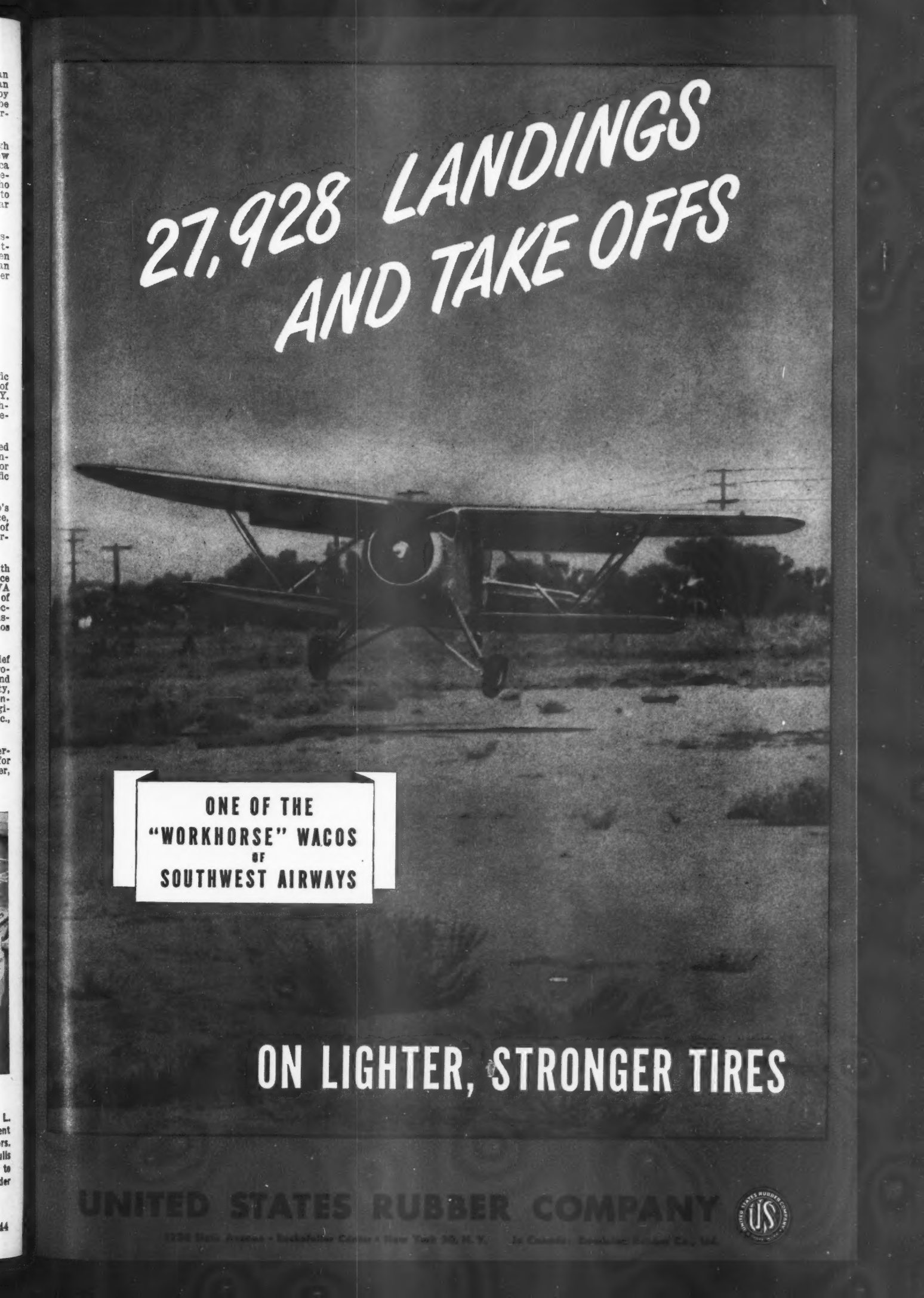
F. C. Thieme, formerly chief engineer of Northwestern Aeronautical Corp., Minneapolis, and of Air Parts, Inc., of same city, is now assistant to **C. S. Robinson,** president and chief engineer of Robinson Aviation, Inc., New York City.

Jerry Kitchen is named supervisor of passenger service for Continental Air Lines at Denver, Colo.



RIGHT AT CITY'S FRONT DOOR

Proposed flying boat terminal, one of several plans prepared by Glenn L. Martin engineers, by which large flying-boats could be berthed adjacent to commercial centers of large cities instead of staying in outer harbors. As shown, plan calls for use of unique horseshoe-shaped tugs, hulls of which fit snugly around flying boat hull to facilitate handling to and from piers. After berthing flying boat, tug can proceed under pier for further assignments.


27,928 LANDINGS AND TAKE OFFS
ONE OF THE "WORKHORSE" WACOS OF SOUTHWEST AIRWAYS
ON LIGHTER, STRONGER TIRES
UNITED STATES RUBBER COMPANY

SOUTHWEST AIRWAYS COMPLETES 1,124,574 MILES OF "FEEDER FLYING"

. . . . without loss or damage to a single ounce of cargo!

In completing over a million miles of feeder lines operations, Southwest Airways' Cargo Division has flown more than 2,900 schedules and handled more than 87,500 pieces of freight totalling more than 2,000,000 pounds.

With stops varying from 16 to 149 miles for an average of 71 miles between landings, Southwest planes have made 27,928 landings and take-offs without loss or damage to a single ounce of cargo.

This great record of accomplishment in feeder line operation was made in pre-war Cabin Model Wacos never intended for this type of grueling service. Under Southwest's direct supervision these "Workhorse" Wacos were rebuilt to handle 72 cubic feet of cargo with a pay load ceiling of 900 pounds.

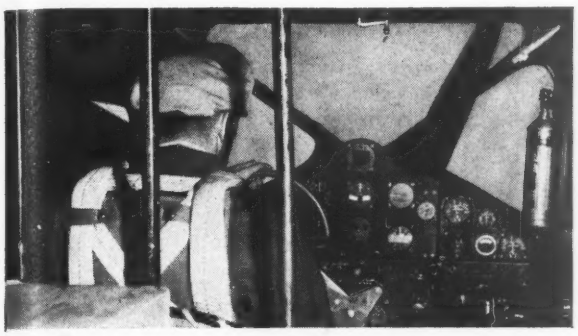
Vigilant maintenance and skill of operation on nearly every kind of landing strip have made Southwest Airways' accomplishment a trail blazer in the field of "short hop" commercial flying . . . another significant step toward the development of speedier, safer, surer air transport after victory.

"Fast taxiing...hard breaking" Capt. Ted R. Mitchell, Operations Manager, Southwest Airways, writes . . . "Operating procedures set up called for fast taxiing, which, in turn, necessitated frequent, hard braking. The intense heat thus built up placed entirely too severe a strain on the original equipment. Tires and tubes gave out in as little as 30 hours flight time. The effective role played by your products enabled us to solve this serious problem."

1230 SIXTH AVENUE **UNITED STATES**

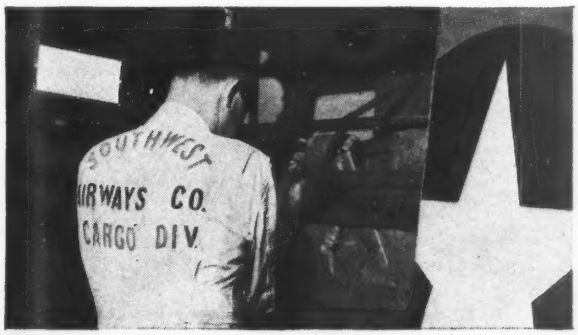
HOW SOUTHWEST CONVERTED ITS PLANES —TO CARRY HEAVIER LOADS

The sturdy Wacos required changes in interior design and construction before they could be transformed from private planes to commercial cargo carriers. Original modification was designed by Southwest Airways' associate company, Southwest Aircraft Corporation. Modification was completed at Southwest Airways own maintenance shops. Here are some of the major changes.



CARGO BARS: Steel cargo bars were installed behind the pilot's seat to guard against shifting cargo.

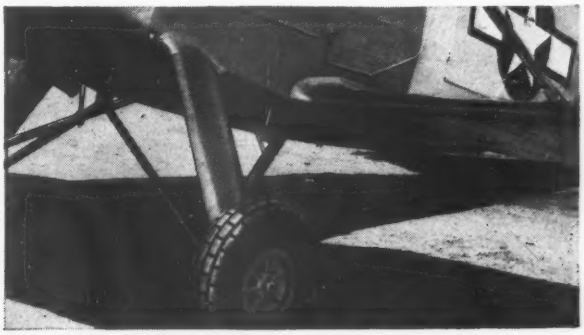
CARGO DOOR: Cargo and pilot doors were cut into the left side of the plane to permit loading of bulky cargo.



CARGO COMPARTMENT: The cargo compartment was increased to maximum size to carry 72 cubic feet of freight.

RADIO EQUIPMENT: Co-pilot's seat was removed and a two-way radio unit installed for constant contact.

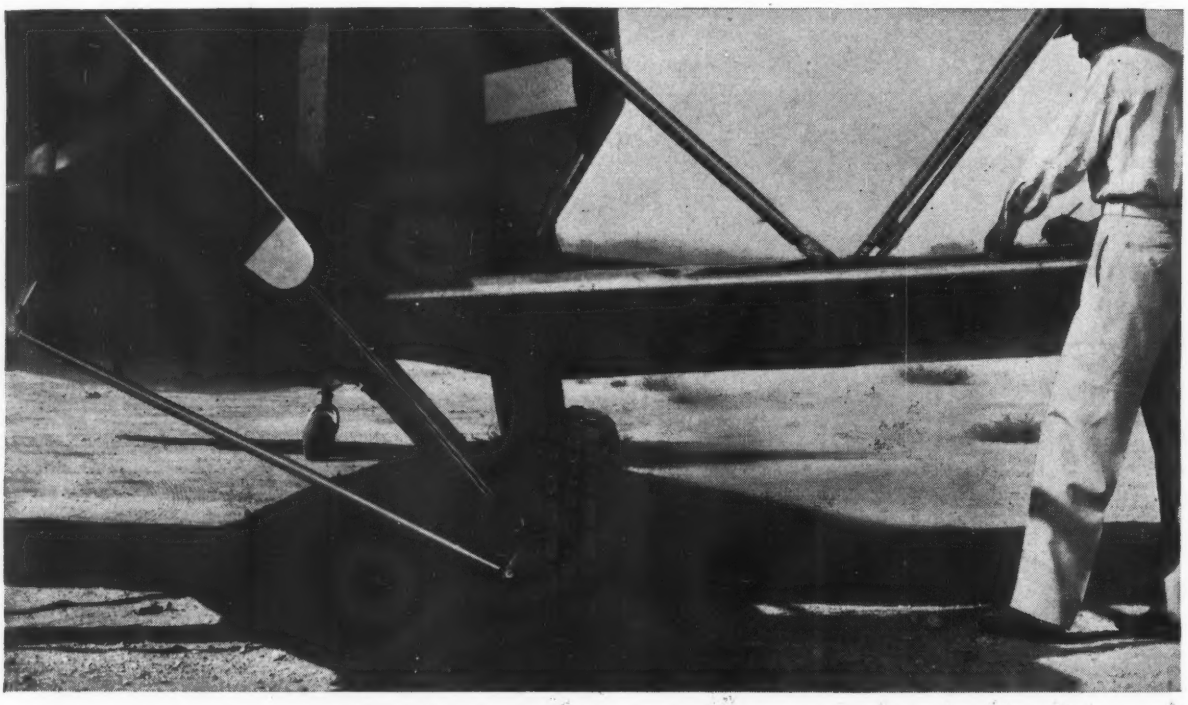
WHEELS: Heavy freight loads were too great for the original wheels. Heavier, more rugged wheels were installed.



TIRES: The same size U. S. Royals that equipped the pre-war Wacos made every one of the 27,928 landings!

RUBBER COMPANY ROCKEFELLER CENTER • NEW YORK 20, N. Y.

FROM 30 HOURS TO 3300 HOURS
WITH U. S. ROYAL FABRIC BASE TUBES



Since the first day of Southwest's feeder line operations, U. S. Royal Airplane tires have equipped their "Workhorse" Wacos . . . and inside every tire is the U. S. Royal Fabric Base tube . . . the tube that increased tire performance, on these planes, 1100%.

Hard braking, fast taxiing, sharp turning built up terrific heat in brakes and wheels. Southwest Airways maintenance engineers called in U. S. tire experts to help find the answer. Taking a leaf from their experience on bus lines where high brake-drum heats are often encountered, they suggested U. S. Royal Fabric Base tubes.

Equipped with these special tubes, introduced to the airplane industry by "U.S.", tire life increased almost overnight. Today, instead of failing after 30 hours of service, Southwest's U.S. Royal Airplane tubes are giving 3300 hours and more . . . are contributing to the outstanding record built up by Southwest in more than a million miles of feeder flying.

This is another example of the practical engineering service "U.S." offers to the aircraft industry through its Field Engineers . . . serving through science to speed the victory.

Lighter, stronger U.S. Royal Airplane tires with bodies of rayon or nylon are serving today on fighters, bombers and transports in every corner of the world, carrying heavier loads safely, surely, dependably.

SERVING THROUGH SCIENCE **TO SPEED THE VICTORY**

UNITED STATES RUBBER COMPANY

1230 SIXTH AVENUE • ROCKEFELLER CENTER • NEW YORK 20, N.Y.

DC-3's, 4's, 6's Ordered By Australian National

. . . Report more new Nazi aircraft . . . Merlin, Sabre rated at "1 hp. per"

First foreign company to officially order American aircraft for postwar air services is Australia National Airways. Contracts have been signed with Douglas for 8 DC-3's, 4 DC-4's, and 4 DC-6's, deliveries to begin as soon as circumstances permit.

Some of these aircraft will be used on ANA's extensive domestic network, while perhaps the larger models will also see service on new international routes contemplated by the company.

It will be remembered that this line purchased a number of DC-3's from Douglas in 1937, and additional Douglases were sent to Australia later under lend-lease.

More New Nazi Craft

The list of new German aircraft types is steadily lengthening. Among the latest said to be under construction are the FW-154 and FW-191, twin-engined fighters, and the FW-300, a six-engine long-range transport.

Further, Heinkel is making the new He-234, four-engine bomber-transport; the He-277, an improved version of the He-177 bomber; and the He-280 jetfighter, powered by two Junkers Juno 004 units. In addition, Messerschmitt has brought out the Me-243 and Me-250, long-range four-engine bombers, and Henschel has the Hs-294, a development of the Hs-293 radio-controlled glider-bomb.

Merlin, Sabre "1 Hp. Per"

Reports have it that both the Rolls Royce Merlin and Napier Sabre deliver 1 hp. per cu. in. of cylinder displacement. Figures given on the former are 1,650 hp. with 1,650 cu. in.; on the latter, 2,220 hp. with 2,240 cu. in.

★INTERNATIONAL BRIEFS★

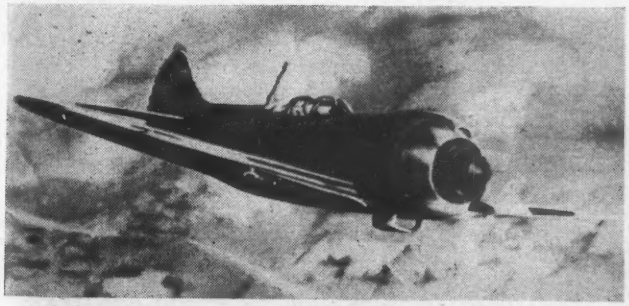
Latest British cease-production order was on Fairey Swordfish, Fleet Air Arm craft which is being replaced by Fairey Barracuda and Grumman Avenger.

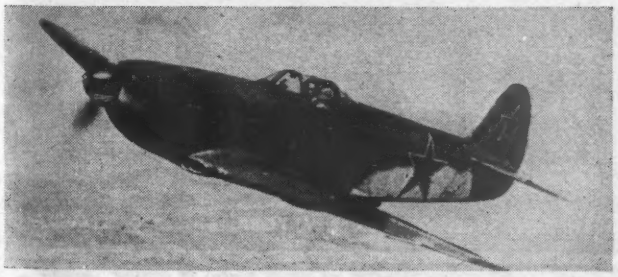
Several virtually undamaged Heinkel He-177's were captured in France, giving experts a chance to study plane's special power installation, consisting of four DB-603 engines—two fitted in each nacelle to drive single props.

RAF Transport Command has started a regular England-to-Cairo service.

Pictures published in England show Bell Kingcobra with two heavy caliber cannon slung under wing, first known use of this specific type of installation on American fighters.

Japs have new four-engine bomber-transport—a midwing 115-ft.-span craft with double tail and having tricycle landing gear. Yanks call it "Liz".





RISING RED STARS

Rarely available are photographs of first-line Soviet fighter planes, some of which reveal thoroughly modern design. LA-5 (top) is one of few Red Air Force fighters using radial aircooled engine. Available data indicates plane has span of 31 ft. 9½ in.; length of 28 ft. 7 in., and high speed of about 375 mph. YAK-3 (above) is one of long line designed by A. S. Yakovlev, all of which have same basic characteristics. (Sovfotos)

WORLDATA . . . . . By "VISTA"

Reports from England announce construction of three Avro Tudors as part of a larger order of 100. Designated as prototypes, these first three aircraft will consist of a transocean version, a continental model, and a short-haul version. A. V. Roe at same time received the "go-ahead" on a larger airliner (for 125 passengers), designed to have a top speed of 325 mph. and a cruising speed of 250 mph. As yet unnamed, this plane would have a 150-ft. span and gross around 60 tons.

Belgian Sabena airline which had been operating various routes in Africa, has finally been able to add the planned link with England. American-built Lockheed Lodestars will be operated on the new Lisbon-touching route. It is expected Sabena will be the first company to reconnect the Belgian homeland with the colonies, with transfer of its base from Southern England to Brussels.

In our September issue, Sweden's conversion to airliners of some downed Boeing B-17's was reported and details of this remodeling have now appeared in the *Aeroplane*. Revamping has brought lengthening of the nose, and there was soundproofing of the fuselage when rear part of the plane was converted into a 14-passenger cabin. Bomb bays meanwhile were made into cargo compartments, to carry loads on trays suspended from the bomb-lifting gear.

Two of these aircraft were delivered in October, enabling ABA to open a domestic service connecting Malmoe, Gothenborg, Stockholm, and Lulea. Another three planes were to be delivered as we go to press. These may be used on the Sweden-England and Sweden-Moscow routes. The Fortresses were availed to Sweden under a loan arrangement with the U. S.

Sixty percent of present British BOAC fleet comprises American aircraft. In service are 29 flying boats—13 Short "C" class, 1 Short "G" class, 11 converted Short Sunderlands, 1 Consolidated Model 28, and 3 Boeing 314's. The latter were sold to BOAC by Pan American. Also in company service are 78 landplanes—9 Short Ensigns, 9 Consolidated Liberator Expresses, 5 DeHavilland Flamingoes, 5 civilian Mosquitoes, 20 Douglas C-47's, 2 Lockheed Electra's, 3 Lockheed 14's, and 25 Lockheed Lodestars.

Interesting new de-icing system has been developed in England by TKS, Ltd., which is a combination of three firms, Tecalemit, Killfrost, and Sheepbridge Stokes. Device utilizing special porous metal, developed by latter company, keeps layer of fluid spread over plane's entire wing and tail surface. The fluid is a development of Killfrost, while special metering and valve equipment was built by Tecalemit. Apparatus with fluid for 5½ hr. of intermittent use is reported to weigh but 400 lb. for a 300-ton four-engined plane.

First non-stop flights between America and Paris since 1927 were completed recently when ATC inaugurated regular service to France.

Sweden reports ATC will shortly start service to Stockholm, and probably Moscow, under direction of Bernt Balchen. Route would be via Iceland.

Russia now has a series of commercial airbases in Siberia, facing Japan and Alaska, and these could be converted to military bases in short order.

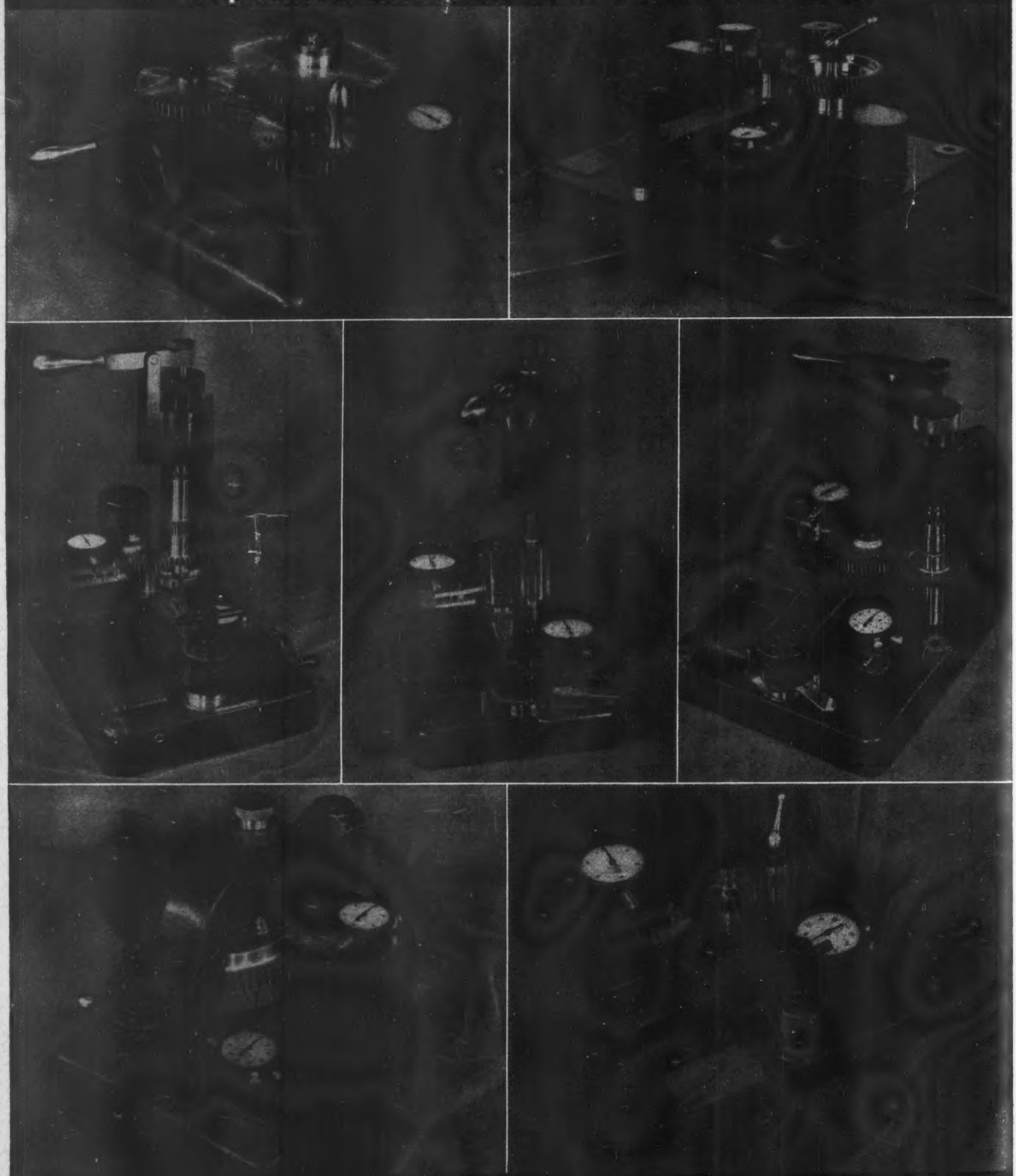
Servicio Aereo Maritimo, S. A., a new Mexican airline, has applied for permission to operate north to San Francisco and east to Havana with amphibians, thus to provide U. S.-Mexico-Cuba run.

Britain's intra-fuselage-jet craft, recently pictured, is a product of the Gloster company (it has initially been miscalled the "Gloucester"). A new report says this plane was first flown on May 15, 1941 by Gloster's Chief Test Pilot P. E. G. Sayer.

Latecoere's big 6-engine flying boat is still undergoing tests, since it suffered aileron flutter which, say reports, hasn't been eliminated. The 70-ton SE-200 flying boat is also still undergoing tests in freed France.

VINCO GEAR ROLLING FIXTURES *with* MASTER GEARS

. . . a positive check for backlash and run-out.



VINCO CORPORATION, 8865 SCHAEFER HIGHWAY, DETROIT 27, MICHIGAN, SALES OFFICES, NEW YORK, CHICAGO, CLEVELAND

MILLIONTHS OF AN INCH FOR SALE BY VINCO

Semi-Automatic Hydraulic Spline and Gear Grinder • Optical Master Inspection Dividing Head • Involute Checker • Angle Tangent to Radius Dresser • Index Plates • Precision Vises • Sine Bars • Straight-side Spline, Serration Spline, Involute Spline and Helical Spline Plug and Ring Gages • Thread Plugs, Rings and Setting Plug Gages • Spur and Helical Master Gears • Munition Gages • Propeller Hub Gages • Built-up and Special Gages • Gear Rolling Fixtures • Spline and Index Fixtures • Hydraulic Power, Control, Utilization and Distribution Units • Engineering, Design and Development.

Northrop Aircraft is simplifying its capital structure by eliminating the Class A and B shares and issuing one class of new common stock on a share-for-share basis. The new stock will be listed on the N. Y. Curb and Los Angeles Stock Exchange. Earnings for the year ended July 31 were $603,515 or $1.50 on the combined A and B stocks, against net earnings of $1.249,535 or $3.13 a share in the previous year.

American Airlines stockholders meet Dec. 6 to vote on a proposal that the authorized common stock be increased from 1,000,000 shares of $10 par value to 2,400.000 shares of $5 par value. Present shares will be split on a two-for-one basis by issuing 1,149,696 new common shares for the 574,848 shares outstanding. The company has called its 50.000 shares of preferred stock for redemption on Jan. 15 and plans to issue 200.000 new preferred shares of $100 par value. Holders of the old preferred may convert into common stock at $70 a share. The recapitalization plan is to provide additional working capital for expansion needs.

Stock Control: The CAB has approved the purchase of a controlling interest in TWA by the Hughes Tool Co., owned by Howard Hughes. Now holding TWA stock valued at more than $5,500,000, Hughes began buying the stock in 1939. At the same time CAB disapproved acquisition of a controlling interest in American Export Airlines by American Airlines.

Grumman Aircraft Engineering Corp. reports net profit for the six months ended June 30 of $6,174,816 or $10.18 a share, against $1.697.108 or $3.34 a share in the like 1943 period. The 1944 earnings are subject to final renegotiation. An estimated $2,015,968 postwar tax refund was transferred to reserves against a similar reserve of $638,843 the preceding year.

Aeronca Aircraft Corp. plans to increase its resources for postwar operations by selling 75,000 shares of $10 preferred stock and 25,000 shares of common stock. It is estimated that the proceeds of the sale will amount to around $725,000 and the money will be used to acquire additional plant facilities and increase working capital.

Transcontinental & Western Air reports for the September quarter net profit of $1,420,553 or $1.46 a share against $872,927 or 90c. a share in the like 1943 quarter. Operating revenues were $7,783,000 against $5,208,674. Net profits for the nine months were $2.04 a share compared with $1.99 a share a year ago.

Unfilled orders: Lockheed Aircraft has unfilled orders in excess of $1,000,000,000, according to Pres. Robert Gross . . . A recent $40,000,000 contract places Ryan Aeronautical's backlog at $70.000,000 according to Pres. T. Claude Ryan. . . Postwar operations of Timm Aircraft are expected to equal present annual volume of $15,000,000, according to estimates by company officials.

Trans-Oceanic Airlines of Wilmington, Del. has ceased to be an investment company within the meaning of the Investment Company Act of 1940, according to an SEC announcement.

National Aviation Corp. reports that net assets per share on Sept. 30 were $18.29 against $17.16 on June 30 and $17 a year ago. Net profit of $148,858 from sale of securities was carried directly to surplus.

Northrop Aircraft has arranged a new V-loan of $18,000,000 at a reduced interest rate to replace the $17,000,000 loan which had expired in September.

Square D Co. reports that for nine months ended Sept. 30 net profit was $1,239,431 or $2.80 a share against net profit of $1,309,006 or $2.96 a share in the like 1943 period.

Parks Air Transport has been incorporated with $3,500,000 authorized capital stock, and it will have $2,000,000 paid-in capital to develop an airline project being organized by Oliver L. Parks, East St. Louis, Ill. An application is pending before CAB for authority to operate 35 air routes in 15 midwestern states. Five Parks training schools will provide $250,000, directors will subscribe to $400,000 of common stock and another $1,350,000 will be raised from sale of common stock.

Mid-Continent Airlines reports net profits for the nine months ended Sept. 30 of $174,642 or 44c. a share against $148,504 or 38c. a share in the like 1943 period.

Dividends: North American Aviation declared a $1 a share dividend payable Dec. 16. A similar payment was made a year ago . . . Ryan paid a 35c. dividend on Nov. 20 . . . Northrop Aircraft has paid a total of 50c. a share against 40c. a share last year . . . Ex-Cell-O Corp. will pay a year-end dividend of 65c. on Dec. 22, bringing total 1944 payments to $2.60, the same as last year . . . Continental Motors will pay 15c. on its common on Dec. 22.

Airplane shares recently were offered to the Swedish public for the first time when a bank syndicate put on the market more than $3,500,000 worth of stock in the Swedish Airplane Co. The company, which was formed in 1937, makes airplanes and accessories. It operates almost exclusively for the Swedish Air Force.

Airplane & Marine Instruments, Inc. reports net earnings for the six months ended June 30 of $293,185 or $1.29 a share. The company earned $149,805 or 66c. a share in the twelve months of 1943.

ADDING IT UP.....By RAY HOADLEY

Dividends. This is the month the majority of aircraft companies hand out dividends to their stockholders, shortly before Christmas. A few years ago practically all plane makers deferred dividend action until near the end of the year. The trend now is towards semi-annual disbursements and, in a growing number of cases, towards quarterly payments, as is the custom in most other industries.

Larger Payments. Dividend payments in the aircraft field will aggregate much larger for 1944 than for any other previous year. In the first nine months of 1944 the average of all dividend payments by concerns listed on the New York Stock Exchange was up 7.2 percent. Aircraft dividend payments were up 15.6 percent in that period, compared with increases of 35 percent for the amusement stocks, 33.6 for the automotive firms, 29 for rubber companies, and 14.5 for the oil companies. Only 8 out of 28 groups failed to show dividend gains, among them the textiles, building construction, commercial credit, and leather units.

Taxes. Some large corporation executives are making their postwar plans on the basis of a 40-percent corporate income tax. They hope it will be lower after the war, but they doubt that it can be, due to the war debt. Nor are they looking for an immediate elimination of the excess profits tax, believing instead that it will be continued at a much lower rate than at present. This would mean that postwar taxes would be several times as high as any previous peacetime levies.

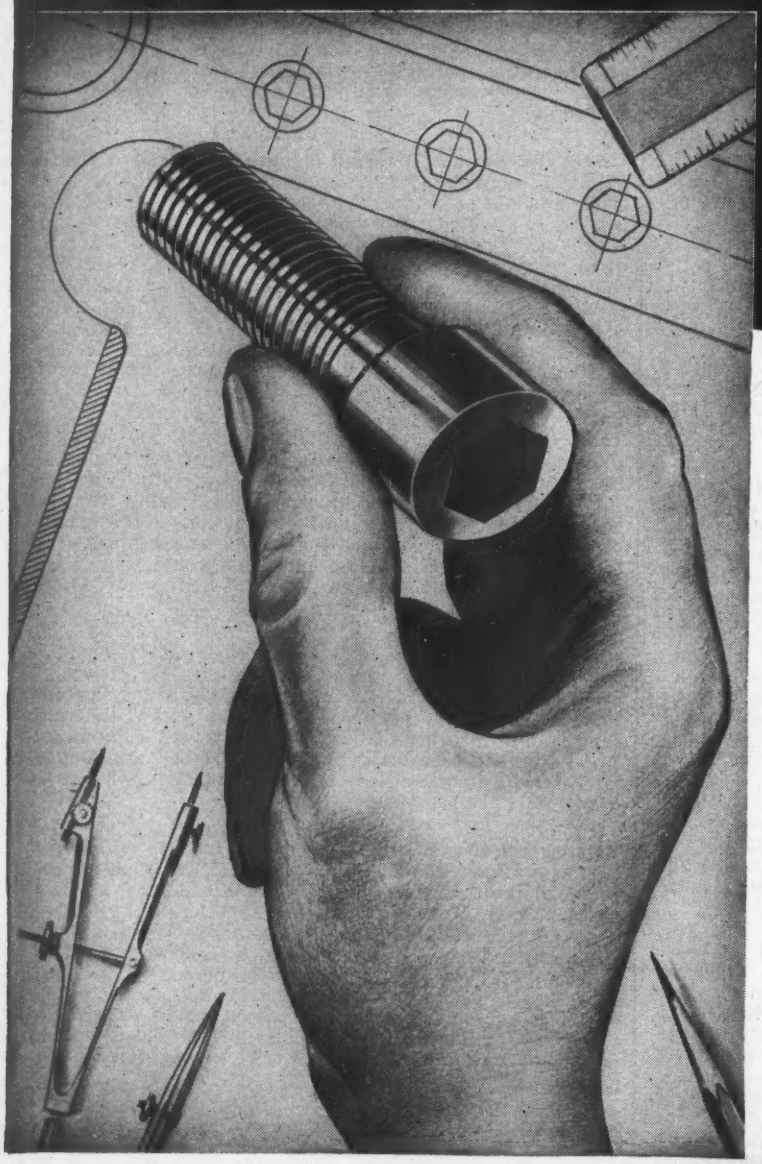
1944 Profits. Some indications point to aircraft earnings this year being slightly ahead of those of 1943. However, as few of the aircraft companies have made interim reports there really isn't much to go on except the fact that volume has been higher for nearly all companies. The Grumman report was highly satisfactory, and Douglas Aircraft, among others, is expected to better its 1943 profit level.

Balance Sheets. Highlight of most aircraft reports on 1944 operations undoubtedly will be a vastly improved financial position compared with that of 1942. In that first war year, working capital was almost pitifully inadequate in relation to sales and also in relation to almost any other industry. But at the end of 1943 working capital had jumped to around half a billion dollars and depreciation reserves were more than half the gross property account. The 1944 balance sheets should show most companies in relatively good shape to face reconversion, provided contract termination works out as well as the government insists it will.

Airline Program. Last July Congress called on CAB to make a special study of multiple taxation of the domestic airlines and report back with recommendations. It is expected the report will be ready before the end of this month and that it will lay the basis for a cooperative federal-state taxation policy so urgently needed for postwar expansion of the airlines.

WHEN *Good Design* CALLS FOR SOCKET SCREWS

Good Judgment CALLS FOR PARKER-KALON *Controlled Quality*

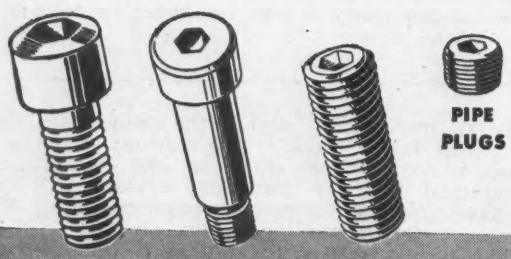


Whenever you specify Socket Screws, it is because you need strength, safety, compactness, or other advantages.

Since you use them when you need an *exceptional* fastening, it is good judgment to make sure you get Socket Screws of *exceptional* quality. At such critical points in your assemblies, you can't afford to have "doubtful" screws . . . screws that *look* all right, but some of which fail to *work* right.

Parker-Kalon's Quality-Control routine, unequalled in the industry, rules out "doubtful" screws by checking every mechanical and physical characteristic. Tests and inspections cover Chemical Analysis; Tensile and Torsional Strength; Ductility; Shock Resistance under Torsion and Shear; Hardness; Head and Socket Size and Position; Thread Fit.

Specify Parker-Kalon Socket Screws next time you order . . . they cost no more. Parker-Kalon Corp., 208 Varick St., New York 14, N. Y.



CAP SCREWS STRIPPER BOLTS SET SCREWS

PARKER-KALON *Quality-Controlled* SOCKET SCREWS

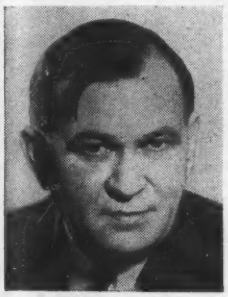
A product of PARKER-KALON . . . Specialists in Fastening Devices

Aviation People

ROBERT M. STANLEY (left) becomes chief engineer of Bell Aircraft's Niagara Frontier division. He had been chief test pilot and manager of Bell's flight research dept. and was the first man to fly the jet propelled Airacomet. Before joining the company in 1940 he had been with Douglas and Vought-Sikorsky. Two other promotions in same div. are a new asst. chief engineer, **JOHN F. STRICKLER** (center) who has been with the Bell company since 1936 and who was project engineer on the Airacuda and also asst. chief project engineer on the P-63 Kingcobra, and **JACK WOOLAMS** (right) who is now chief test pilot. The latter, who formerly was senior experimental pilot and asst. chief test pilot, conducted the high altitude tests on the company's Airacomet.

MAJ. CHARLES E. HARNER has joined Hill & Knowlton after two years in the AAF, now being on inactive status. Prior to going into the Army, he engaged in financial and aviation writing, was an AP foreign correspondent, and also was with N. W. Ayer.

RICHARD J. STEVENS has been made superintendent of overhaul at TWA's home maintenance base. He had been regional maintenance supervisor at airline's La Guardia Field base since 1942. In new position he succeeds Verde A. Blackwell, who died last August.



CHARLES W. FRANCE (left) Curtiss-Wright vice-pres. and gen. manager of company's airplane division at Buffalo, returns to St. Louis plant as general manager. At the same time **N. F. VANDERLIPP** (right) becomes general manager of Buffalo plant, leaving Columbus, Ohio, factory where he had held position of manager for more than a year. In addition he will coordinate Navy experimental work with the activities of the Columbus plant. Both men will be concerned with stepping up production of C-46 Commandos.

KEN ELLINGTON becomes manager of N. Y. C. office of Aircraft Manufacturer's Council, ACCA, where he will coordinate regional activities of Eastern companies. He has been secretary of AWPC East and consultant to Hill & Knowlton. (Blackstone Studios photo)

R. O. BULLWINKEL (left) for more than a year asst. to pres. of Northwest Airlines, western region, has been placed in charge of all traffic on the NWA system. In his new position he will direct coordination of all traffic and also sales activities. **COL. W. FISKE MARSHALL** (right), formerly operations mgr. for NWA, has returned as executive asst. to pres. He was organizer and commander of famed South Pacific SCAT, was awarded Presidential Unit Citation for his work at Guadalcanal, also won Legion of Merit.

ARTHUR E. SMITH is appointed asst. chief engineer of P & W aircraft div. of United Aircraft Corp. For the past two years, he had been chief engineer of company's Missouri plant, where he supervised all engineering activities as new R-2800-C engine went into production. He came to P & W company in 1935.

ERNESTO FRANCO becomes legal adviser for TACA Airways agency. He will handle the twelve TACA companies in Central and South America. Previously he had been associated with Pan American-Grace Airways in the capacity of legal and administrative assistant to Company Vice President Vidal.

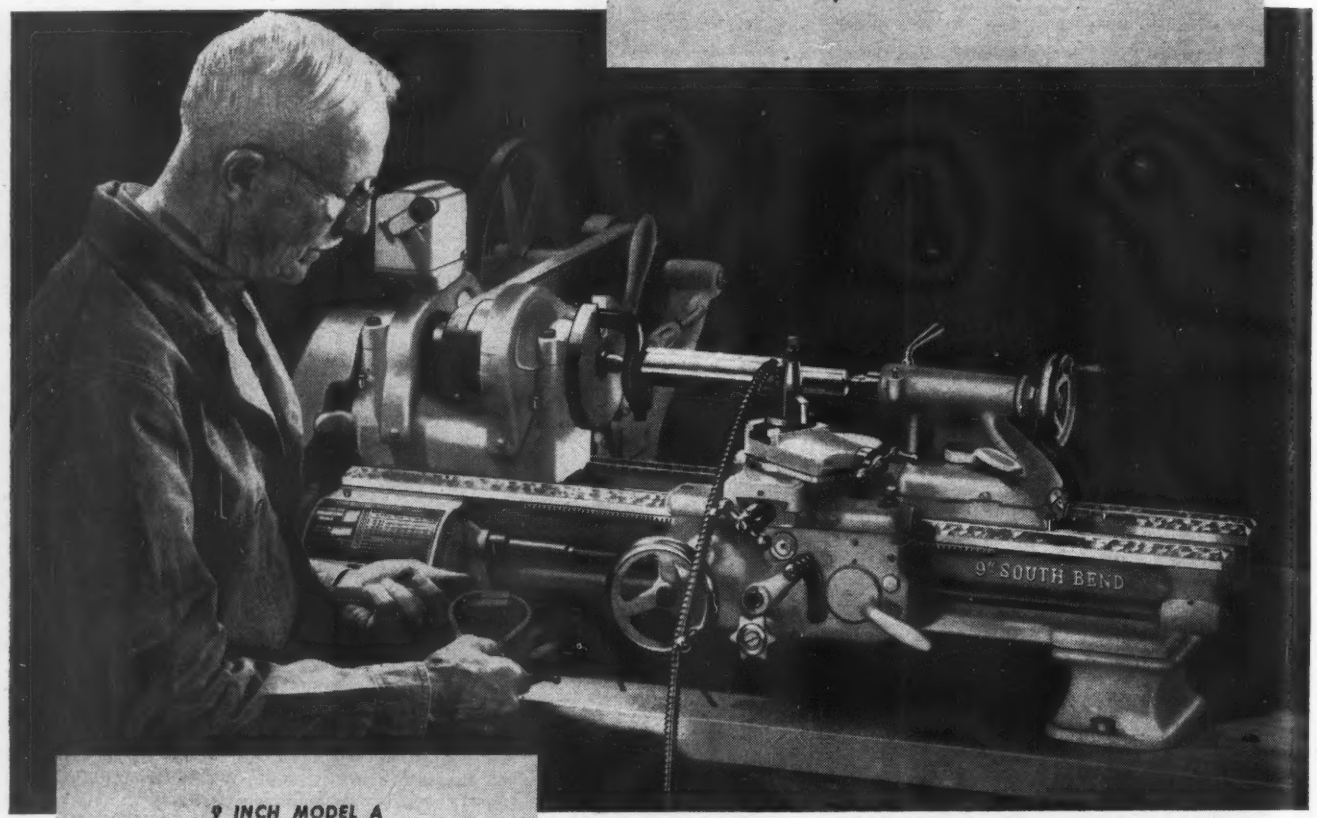
OMER L. WOODSON has moved to Ryan Aeronautical Co. as firm's new vice-pres. and gen. mgr. One of country's ablest men on volume production, he comes to his new post from Bell organization, where he had been gen. mgr. of Marietta B-29 plant since 1942. He will handle production on Ryan's new Navy plane.

PETER ALTMAN joins Aeronca Aircraft Corp., Middletown, Ohio, as consulting engineer. Previously he had been head of Aeronautics Department, University of Detroit, had also organized and directed Vultee's manufacturing research department, and worked on development of Stinson models.

FREDERICK JOHN KNACK, aeronautical engineer and designer, is named vice-pres. in charge of engineering for Luscombe Airplane Corp., Trenton, N. J. He comes from Fairchild, where he formerly handled AT-21 production and later was eng.-in-charge at company's N. Y. C. office.

9 INCH
SOUTH BEND
Precision
LATHE

. . . . FOR THE MANUFACTURE OF SMALL ACCURATE PARTS IN PRODUCTION SHOPS . . FOR PRECISION OPERATIONS IN TOOLROOMS, EXPERIMENTAL SHOPS, AND LABORATORIES



9 INCH MODEL A

SOUTH BEND LATHE FEATURES

Fine workmanship by experienced machine tool craftsmen.

Superfinished spindle with large bearings.

Direct belt drive to spindle for smooth, quiet operation at high speeds.

Back-geared drive for heavy cuts and low spindle speeds.

Full quick change gear mechanism.

Thread cutting range—4 to 224 per inch, right hand and left hand, 48 pitches.

Precision lead screw for thread cutting.

Worm drive and friction clutch for power longitudinal feeds and power cross feeds.

Three hand-scraped V-ways and one flat way on the bed insure perfect alignment of headstock, saddle, and tailstock.

Whether your problem is the quantity production of small, accurate parts, or the efficient machining of small work in the toolroom, experimental shop, or laboratory, you will find a lot of possibilities in the 9-inch South Bend Lathes. Modern in design, built with the same care as the larger sizes of South Bend Lathes, they are fast, accurate, and versatile. Substantial savings in capital investment, power consumption, floor space, and labor costs have often resulted from their installation.

In addition to the 9-inch Lathes, we manufacture 10″, 13″, 14½″, and 16″ lathes in Quick Change Gear and Toolroom types. Also the Series 900 and Series 1000 Precision Turret Lathes having ½″ and 1″ collet capacity respectively. Write for a catalog, stating the size and type of lathe you need.

TRAINING HELPS

Sound films, operator's handbooks, wall charts, booklets, and bulletins on lathe operation and care are available for training new lathe operators. Write for Bulletin No. 21-D for full information.

ARMY E NAVY

SOUTH BEND LATHE WORKS

LATHE BUILDERS FOR 38 YEARS • SOUTH BEND 22, INDIANA

THE OLD MAINTENANCE MAN was reminiscing about his early mail plane servicing days when the DH-4's out in the northwest were coming consistently down with dead engines. After the usual diagnosis revealed nothing wrong, and the engine would run up beautifully, the pilot would again take off, sometimes getting through to his destination. Anyway, our friend thought he had the answer when one of them staggered onto the home field—under full throttle—and he was able to discover ice in the carburetor. In high glee they built the parts necessary to take heat off the exhaust manifold to keep the carburetor warm. Then the engine ran excellently on the ground—but conked cold soon after takeoff. "We had," he said, "designed and constructed the first built-in vapor lock."

• This same old timer had wonderful definitions for preventive and corrective maintenance. "When the blankety-blank thing won't fly, your preventive maintenance has been lousy and you gotta resort to corrective maintenance."

• The millenium, it seems, is here. At long lawst a Britisher has admitted that the Empire is not leading the world in every endeavor. In the House of Lords the other day, Lord Beaverbrook said—right out loud, too—that these United States have an edge in air transport development. Which confuses us no end, for their propaganda services have certainly been trying hard, and not too subtly, to give the idea that the Avro *Lancaster* is the ready answer to the transport operator's dream, and that the stuff coming up any day now will simply make everything conceived outside the tight little isle completely obsolete and shabby by comparison. Can it be true that in Britain, too, the right hand knoweth not what the left is not doing?

• During that same discussion Lord Brabizon asked the perennial British question: Why do we modest Britishers insist on hiding our light under a bushel? As his example he declared that the Gloster squirt plane could fly rings around the Bell jet plane. P'raps m'lud was thinking of the Bell Helicopter—it does, among other things, a swell job of hovering.

• One instrument man with an eye on maintenance may have his old grammar teacher spinning in her grave, but he gets his point over. On all gyro compasses turned out by his department he has had painted in big, bright red letters this warning: "Do not jar. Handle like eggs."

• It's oft been said that aircraft salesmen as well as designers are slightly nuts, and it's small wonder the adjective "slightly" is used. Other day, for example, a newspaper wanted a price on one of the country's most popular three-place 165-hp jobs. But before closing the deal they just wanted to be sure the thing would carry, in addition to the pilot, two reporters, one photographer, and a dark room.

• Man looking over our shoulder here said the salesmanager should have talked them out of the darkroom—said just put the thing into a 9-G dive and quick-like-a-rabbit develop the pictures during the blackout.

• Within the week this same sales manager got a call from a magazine. They wanted the same kind of plane, but first demanded exact operating costs for the job with an 1,800-lb. press installed.

• Gentlemen, there just ain't no romance left in this business of air transportation. Final proof of this sad, sad state of affairs was given recently when American Airlines flew 5,000 lb. of spinach east from California. And when you start lugging spinach around you've taken all the glamor out of the business.

"Maguire's going to corner the whole airplane market with the maintenance man's dream ship."

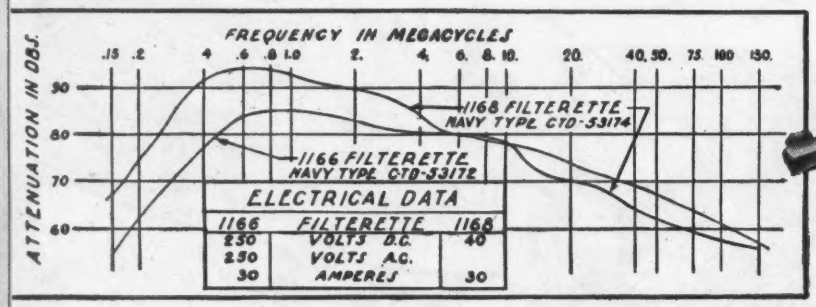
IN THE FIELD OF RADIO NOISE ELIMINATION TOBE IS THE ACKNOWLEDGED LEADER

ONE engineering result of the war is increased knowledge of radio interference problems. It will never be lightly treated again. No engineer can tackle the development of an electrical design without giving due consideration to minimizing the radio interference it creates in operation. Specially designed filters, to be built into electrical circuits, can usually solve the problem of radio interference.

Here at Tobe is a great storehouse of knowledge in this subject. It is *sound* knowledge, gained by the most intense interest and experience of any company in the field.

Tobe Filterizing is a copyright term. It means that Tobe knows how to "filterize" man-made radio noise. Why not make use of this valuable 16 years' of experience in your own engineering? Place your reliance on Tobe and the famous Tobe Filterettes. Send us your problems now.

LONG LIFE ASSURED!



CONTAINER DIMENSIONS

Length . . 4 7/16" Width . . 2 1/8" Height . . 2 7/8" Overall length 6 1/4"

SUPPRESS MAN-MADE RADIO STATIC

TOBE FILTERIZED

Tobe Deutschmann Corporation

CANTON, MASSACHUSETTS

A small part in Victory Today — **A BIG PART IN INDUSTRY TOMORROW**

KEEP POSTED ON
Products and Practices

This selected information on new publications and products is offered by the "AVIATION" Reader's Service through cooperation with the manufacturers. It helps executives save valuable time, provides profit through convenience. To obtain literature or additional data on new products described, simply fill in form below, clip it to your letterhead, and mail. There is no cost, no obligation.

ENGINEERING DATA

Screw Thread Charts.....1

Engineers Specialties Div., Universal Engraving & Colorplate Co., Buffalo and Cleveland, offers new circular, *Screw Thread Comparator Charts,* covering American National fine threads and American National coarse threads, both for class 2 and 3 fit. Elimination of duplicate charts makes possible checking of from 1 to 7 sizes on individual charts. —AVIATION, Dec. '44.

Company's History and Plans.....2

Booklet from Thompson Products Inc., Cleveland, contains story of company's business during past 10 yr., describes products and processes, and outlines plans for future.—AVIATION, Dec. '44.

New Lofting Method.....3

Mechanical reproduction of full-sized detail drawings directly on tooling materials is described in new booklet, *Precision Lofting,* issued by Template Reproduction Co., Philadelphia. Emphasized is speed and accuracy of method.—AVIATION, Dec. '44.

Forgings Bulletin.....4

To be published periodically by The Brass Forging Assn., New York, is new bulletin, *Non-Ferrous Forgings Digest.*—AVIATION, Dec. '44.

Resistance Welding.....5

Information is available from Resistance Welder Manufacturers Assn., Philadelphia, regarding spot welding in manufacture of seaplane mooring bit assembly, with methods employed at Glenn L. Martin Co., Baltimore plant, being described.—AVIATION, Dec. '44.

De-Icer Shield.....6

Manual of operation, maintenance, and service of company's de-icer shield for aircraft windshields has been prepared by Raymond De-Icer Co., Los Angeles. Described are characteristics and installations.—AVIATION, Dec. '44.

Nitrocellulose 7

Beginning with information on the derivation of nitrocellulose, 58-page textbook-type brochure on properties and uses of this product contains chapters on manufacture, types, solubility, and viscosity. Also included are tables and specifications. This publication has been issued by Hercules Powder Co., Wilmington, Del.—AVIATION, Dec. '44.

PRODUCTION

Metal Inspection X-Ray.....8

Information is available on new 2,000,000v. x-ray tube developed for inspection of thick sections of metal. Issued by Machlett Laboratories, Springdale, Conn., it states that exposure time of 1 wk. with 1,000,000v. is now reduced to 1 hr. with 2,000,000v.—AVIATION, Dec. '44.

Heat Resisting Paint.....9

Catalog, color card, and bulletins on high heat resisting paint are being distributed by Quigley Co., New York City.—AVIATION, Dec. '44.

Heat Treating.....10

Job shop service on electronic induction heat treating of metals is topic of circular from Central Boiler & Mfg. Co., Detroit. Folder cites advantages of process.—AVIATION, Dec. '44.

Plating Rack Protection.....11

B. F. Goodrich Co., Akron, has issued new catalog section on Koroseal tape RX and Korolac RX (Koroseal solution) protective coatings for plating racks. Characteristics, properties and instructions for use are given.—AVIATION, Dec. '44.

Metal Degreasing.....12

Outlining fundamentals of degreasing-machine design, installation, and operation, booklet from E. I. duPont de Nemours & Co., Wilmington, Del., lists standard practices for degreasing metals with chlorinated solvents.—AVIATION, Dec. '44.

Thread-Cutting Screws.....13

Circular from Shakeproof, Inc., Chicago, describes thread-cutting screws and their applications. Included here are pertinent engineering drawings.—AVIATION, Dec. '44.

Tool-Steel Electrodes.....14

Data on metallic arc tool steel welding is contained in manual and catalog from Welding Equipment & Supply Co., Detroit. Applications and procedures are given.—AVIATION, Dec. '44.

Hydraulic Cylinders.....15

Bulletin 401-C from John S. Barnes Corp., Rockford, Ill., gives specifications of hydraulic cylinders and suggests applications stated to improve machinery designs.—AVIATION, Dec. '44.

Miniature Ball Bearings.....16

Miniature Precision Bearings, Keene, N. H., offers Bulletin No. 44, describing line of miniature bearings for instrument, industrial, and special uses.—AVIATION, Dec. '44.

Tool Salvage.....17

Topic of tool salvage by brazing is covered in bulletin from Handy & Harman, New York City.—AVIATION, Dec. '44.

MACHINERY & ACCESSORIES

Metal Cutting Saw.....18

New metal cutting saw having full mechanical drive is described in Bulletin MC-51 from Peerless Machine Co., Racine, Wis. Among new features is compensating feed unit.—AVIATION, Dec. '44.

Melting Furnaces.....19

Fisher Furnace Co., Chicago, has issued new catalog describing line of melting furnaces, recommended applications, and giving the capacities and dimensions.—AVIATION, Dec. '44.

Angle-Forming Instrument.....20

"Radiform," new radius and angle forming instrument reported to perform wide range of operations in improved manner, is described in circular from W. F. Meyers Co., Bedford, Ind.—AVIATION, Dec. '44.

Radius Dresser Insert.....21

Two new models of radius dressers are described in circular from U. S. Tool & Mfg. Co., Dearborn, Mich. Model 45 is described as adaptable to all radii including 4½ in. and is stated to be suitable for

AVIATION READER'S SERVICE

AVIATION, 330 W. 42nd St., New York City 18

DECEMBER 1944

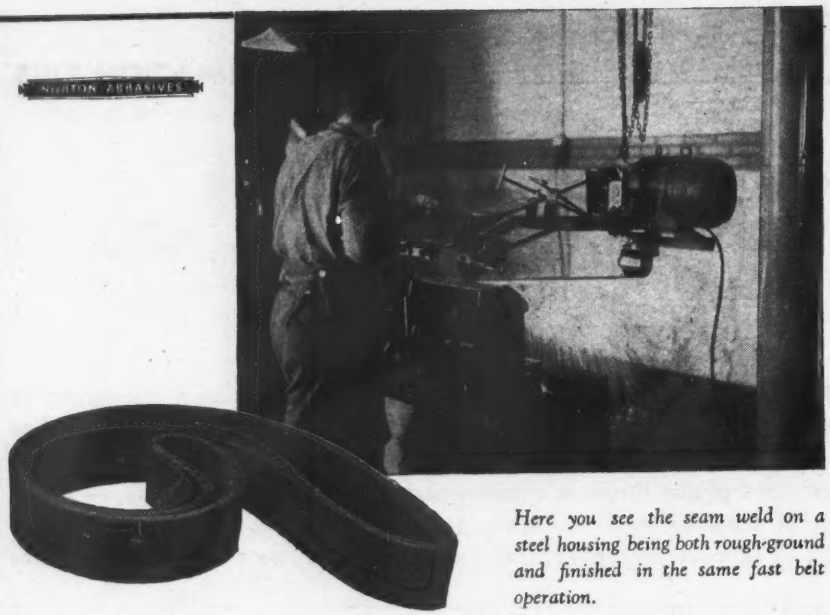
Please send me additional information according to key numbers circled.

INFORMATION TIPS:						1	2	3	4	5	6	7	8	9	10	11	12
13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
49	50	51	52	53	54	55	56	57	58	59							
NEW PRODUCTS:					60	61	62	63	64	65	66	67	68	69	70	71	72
73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100	101							

NAME.....TITLE.....

FIRM OR AFFILIATION.....

ADDRESS.....



Here you see the seam weld on a steel housing being both rough-ground and finished in the same fast belt operation.

Note the shower of sparks! Yet the belt disperses heat quickly.

METALITE CLOTH BELTS
Improve Swing Frame Grinding

NATURALLY! Their greater area and sharper surface obviously provide cooler, faster cutting and better finish.

A maker of stainless steel tanks for milk trucks, where finish was paramount, was influenced by one of our men to adopt this modern method for polishing the entire inside of the huge saucer-shaped ends.

Result: One man, one shift, now keeps ahead of a schedule that formerly required two men, two shifts.

If you run a Swing Frame Belt Grinder, send for our brochure "Metalite Cloth Belts Improve Swing Frame Grinding." If not, we can send you manufacturer's literature on the Grinder itself. Here's a handy coupon.

BEHR-MANNING · TROY, N. Y.
(DIVISION OF NORTON COMPANY)

BEHR-MANNING · TROY, N. Y.
Please send the following literature:
.....Metalite Cloth Belts, etc. .....The Swing Frame Abrasive Belt Grinder.
Firm Name_____
Street_____
City_____ Zone_____ State_____
By_____ Title_____

concave or convex dressing, while Model 124 is angle-correcting dresser, max. radius 1⅛ in., designed for correcting radius on wheel for grinding compound and compound-complex forms on flat-form tools.—AVIATION, Dec. '44.

Micro-Form Grinder.....22

Booklet from The Sheffield Corp., Dayton, Ohio., describes new micro-form grinder for production of profiles direct from drawing. Principles are detailed and applications illustrated.—AVIATION, Dec. '44.

Drill-Press Attachment.....23

How to convert single spindle drill press for multiple spindle production work is described in circular announcing the new Madco drill press turret attachment. Made by Machine Development Co., New York City, new device is stated to make possible six consecutive drilling operations (spot-facing, drilling, counter-boring, reaming, etc.) without changing tools.—AVIATION, Dec. '44.

Dust-Collector Catalog.....24

Feature of new catalog on dust collectors, issued by Aget-Detroit Co., Ann Arbor, Mich., is special indexing. References are given according to grinder sizes (instead of collectors) and by specification of source of dust in list, referral to proper collectors is made.—AVIATION, Dec. '44.

Variable Speed Drive.....25

New variable speed drive by Lombard Governor Corp., Ashland, Mass., is described in circular as special development for modernization of old machinery and manufacture of new, in that it provides new possibilities of use of geared drive power transmission in medium and higher horsepowers.—AVIATION, Dec. '44.

Lift Truck.....26

Circular from Hyster Co., Portland, Ore., describes Model 150 fork-type lift truck stated to have new high rating for work capacity.—AVIATION, Dec. '44.

Tapping Machine.....27

Described as being capable of simultaneously tapping three different sized holes up to 1 in., "Tapmaster", 3-spindle automatic tapping machine made by D. H. Prutton Machine & Tool Co., Cleveland, is introduced in new circular.—AVIATION, Dec. '44.

Tap Manual.....28

Manual containing notes on proper selection of taps and providing tables covering tap fits, basic thread dimensions, and tap drill sizes, has been issued by Charles H. Besley & Co., Chicago. Included are recommended speeds, lubricants, and angle of cutting face for various metals.—AVIATION, Dec. '44.

Torque Tool Manual.....29

Giving tables, formulas, and a graph as aids to determine relative shearing torques for machine screws and studs, new booklet issued by Apco Mossberg Co., Attleboro, Mass., also includes elementary definitions which relate to torques.—AVIATION, Dec. '44.

Compressed-Air Cooling.....30

Bulletin 98 from Niagara Blower Co., New York City, details new method of compressed-air after-cooling and gives specifications of company's "Aero" after-cooler.—AVIATION, Dec. '44.

Measuring Instruments.....31

Catalog covering dial indicators, micrometers, comparators, cylinder gages, and thickness measures is announced by B. C. Ames Co., Waltham, Mass.—AVIATION, Dec. '44.

Cable Splicer.....32

Garlinghouse Bros., of Los Angeles, offers circular on portable splicing rig for wire cables.—AVIATION, Dec. '44.

Hole Punching.....33

Equipment, methods, and applications of "CD" hole-punching system are described in new Catalog CD issued by Wales-Strippit Corp., North Tonawanda, N. Y.—AVIATION, Dec. '44.

Injection Molding.....34

Lester-Phoenix, Cleveland, offers booklet *Shaping the Things of Tomorrow* in

which is described equipment and methods used in injection molding.—AVIATION, Dec. '44.

Fluid Metering.....35

Designed for aircraft anti-icing and heater applications, Series "K" fluid metering pump, made by Adel Precision Products Corp., Burbank, Calif., is described in new circular issued by company.—AVIATION, Dec. '44.

Lathe Catalog.....36

Complete line of lathes is described, with data on capacities, speeds, feeds, and dimensions, in new catalog from South Bend Lathe Works, South Bend, Ind.—AVIATION, Dec. '44.

Electric Unit Heaters.....37

Bulletin 44-U, from Electric Air Heater Co., Mishawaka, Ind., describes line of ceiling, wall, and post suspension electric unit heaters.—AVIATION, Dec. '44.

Industrial Trucks.....38

Industrial trucks and tractors manufactured by Mercury Mfg. Co., Chicago, are described in catalog just issued.—AVIATION, Dec. '44.

Chucking Reamers.....39

Dimensions and other information on spiral-fluted chucking reamers is contained in circular from Chicago-Latrobe Twist Drill Wks., Chicago.—AVIATION, Dec. '44.

Liquid Storage.....40

Circular from Bowser, Inc., Fort Wayne, Ind., contains descriptions and specifications of liquid storage, handling, and dispensing equipment.—AVIATION, Dec. '44.

Molding Machine.....41

New 16-oz. capacity plastics injection molding machine is announced by Hydraulic Press Mfg. Co., Mt. Gilead, Ohio. Information including diagrams is available.—AVIATION, Dec. '44.

Metallizing Equipment.....42

Descriptive catalog of metallizing accessories is offered by Metallizing Co. of America.—AVIATION, Dec. '44.

PLASTICS

Plastic Tank Linings.....43

Udylite Corp., Detroit, offers circular on Koroseal tank linings, stated to be highly resistant to acids and corrosives. List of metal-finishing chemicals is included, and resistance of linings is indicated.—AVIATION, Dec. '44.

Molding Material.....44

Chemaco Corp., Berkeley Hts., N. J., announces "Polystyrene", new thermoplastic molding powder. Booklet describes physical properties of powder and lists applications.—AVIATION, Dec. '44.

Plastic Materials.....45

Applications of "Plaskon" materials to needs of molding industry are given in booklet from Plaskon Div., Libbey-Owens-Ford Glass Co., Toledo, Ohio. Each type is described, and special section of booklet is devoted to "Plaskon" resin glue.—AVIATION, Dec. '44.

ELECTRICAL

Aircraft Test Equipment.....46

Airplane Mfg. & Sup. Corp., N. Hollywood, Calif., has issued new catalog on aircraft test and service equipment.—AVIATION, Dec. '44.

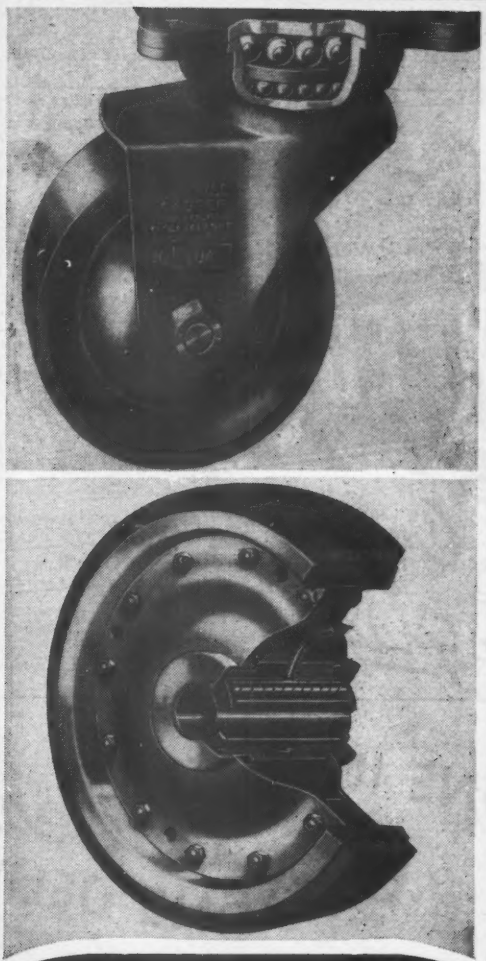
Thermistors 47

Information is available on new thermistors manufactured by Western Electric Co., New York City. Units (initially designed by Bell Telephone Laboratories) are small circuit elements made of mixture of metallic oxides which are pressed into disks, extruded into rods, or formed into tiny beads.—AVIATION, Dec. '44.

Capacitors 48

General Electric Co., of Schenectady, N. Y., has issued circular announcing "Lectrofilm" capacitors, which are stated to be mechanically interchangeable with

Darnell Casters
& E-Z ROLL WHEELS



Darnell Dependability assures savings, service, safety, speed. A caster or wheel for every use.

DARNELL CORP. LTD. LONG BEACH 4 CALIFORNIA
60 WALKER ST. NEW YORK 13 N.Y.
36 N. CLINTON CHICAGO 6 ILL.

mica capacitors. Units are described as suited for radio-frequency blocking and by-pass applications in communications and other electronic equipment.—AVIATION, Dec. '44.

Welding Equipment.....49

Welding and assembly positioning equipment is pictured, diagrammed, specified, and described in Bulletin No. 2156 from Ransome Machinery Co., Dunellen, N. J.—AVIATION, Dec. '44.

D.C. Solenoids.....50

Cannon Electric Development Co., Los Angeles, has issued new bulletin on d.c. solenoids. Tabular data, dimensional drawings, wiring diagrams, and response characteristics charts are included.—AVIATION, Dec. '44.

MANAGEMENT & EMPLOYEES

Duplicator 51

Information is available on new "BW-Copyflex" printer, stated to be capable of duplicating anything drawn, typed, printed, or illustrated. Maker is Chas. Bruning Co., Chicago.—AVIATION, Dec. '44.

Buyers' Encyclopedia.....52

Catalog on supplies and apparatus for fire fighting, first aid, safety, and industrial maintenance has been issued by General Detroit Corp., Detroit.—AVIATION, Dec. '44.

Objective Tests for Workers.....53

New type of illustrated objective tests for workers has been developed by American Technical Society, Chicago. Tests are described as eliminating lengthy written answers. Workers identify tools, correct operations, applications, and procedures by checking illustrations.—AVIATION, Dec. '44.

Film on Welding.....54

New Horizons in Welding is title of film dealing primarily with set-up for production welding. Step-by-step procedure is pictured. Film has been released by Harnishfeger Corp., Milwaukee.—AVIATION, Dec. '44.

Mobile Canteens.....55

S. Blickman, Inc., Weehawken, N. J., has issued catalog describing line of mobile canteens for industrial establishments.—AVIATION, Dec. '44.

Power History.....56

Review of man's efforts in transmitting power is topic of booklet *From the Shadoof to the Dominant Drive*, offered by Multiple V-Belt Drive Assn., Chicago.—AVIATION, Dec. '44.

Employee Relations.....57

Brochure from Raybestos Div., Raybestos-Manhattan, of Bridgeport, Conn., covers achievements of members of organization in working together for common welfare.—AVIATION, Dec. '44.

Carbide Tool Grinding.....58

Grinding Carbide Tools is title of industrial training film offered by Norton Co., Worcester, Mass.—AVIATION, Dec. '44.

Airfield Turf.....59

O. M. Scott & Sons Co., Marysville, Ohio, has issued booklet on development and care of heavy turf considered desirable for landing fields.—AVIATION, Dec. '44.

ONE INQUIRY—
One Order—
ONE DELIVERY

Rapid service, via GRAYBAR, is an old story to many procurement men in the aviation industry.

GRAYBAR has substantial stocks of many of the electrical materials which go into building today's airplanes. Their more than 80 warehouses all over the United States, are located so that one of them is in or near every large aviation center. The products of more than 200 manufacturers flow to you via GRAYBAR. This great distributing and service organization now has become first Service of Electrical Supply to the aviation industry.

A single call to your local GRAYBAR office puts GRAYBAR facilities all over America at your disposal. For Electrical supplies, call GRAYBAR *first*.

3532

GraybaR
IN OVER 80 PRINCIPAL CITIES
EXECUTIVE OFFICES: GRAYBAR BUILDING, NEW YORK 17, N. Y.

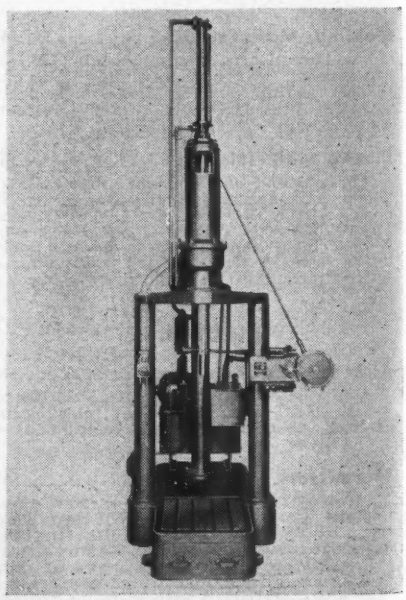
GraybaR QUALITY 75 YEARS OF Electrical Distribution

NEW PRODUCTS

Latest Machine Tools

Honing Machine 60

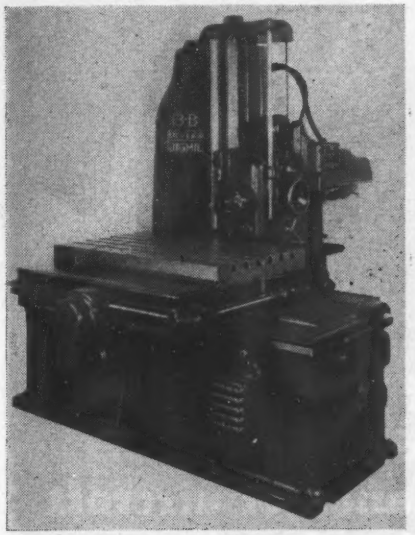
Developed for honing or lapping of aircraft engine cylinders, new honing machine made by **C. Allen Fulmer Co.**, Cincinnati, is also adapted for finishing con-



necting rods, supercharger parts, landing gear struts, and recoil cylinders. Machine can be supplied in various working stroke lengths up to 72 in., and with cylinder honing capacities up to 20 in. i.d. Controls are at floor level and coolant is in base.—**AVIATION, Dec., '44.**

Milling Machine 61

Refinements in Model 3-A "Jigmill" are announced by **DeVlieg Machine Co.**, Ferndale (Detroit), Mich., and new model is called 3-B. Features are stated to be: Automatic positioning in response to precision end measuring rods and push but-



tons; feather touch controlled pressure locking means for slides, affecting uniform treatment of oil film; improved automatic table retraction. Control station is mounted on spindle head and travels with head and operator. No electronics are employed. Five motors furnish power. Machine has 24 spindle speeds from 22 to 1,200 rpm. Bar feeds are in thousands per rev. from .001 to .016. Milling feeds to table and head are in inches per min. selected with dial quick-change mechanism providing range from .3 to 15 in. per min. Table dimensions are 30 x 48 in. Range dimensions of travel are horizontal movement 48 in., vertical 37 in., starting with center 1 in. below top of table and extending to 36 in. above. Bar movement is 16 in., and provided are extra means for resetting six additional inches. Retraction movement on table is 16 in.—**AVIATION, Dec., '44.**

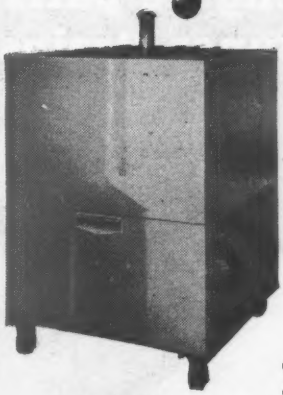
Powdered-Metal Press 62

Designed to simplify powdered-metal molding operations, new hydraulic press of 400-ton capacity vertical ram, and 300-ton capacity horizontal ram, made by **Watson-Stillman Co.**, Roselle, N. J., is stated to feature: Double acting; pulsationless pressure application; stepless pressure adjustment; and automatic cycle controls. Micrometer adjustment of pressure is provided on working stroke. Mold size is 6 x 7 x 30 in. Pressure is provided by radial piston pump, driven by 30 hp. motor, and machine has push-button, solenoid-operated pilot valve for down and forward movements of ram, while hand lever operates return movement. Operating speeds of vertical ram are 238 in. per min., advance and return; 17.5 in. per min., pressing. Horizontal ram advance and return speeds are both 21.6 in. per min. Press is 11 ft. 6 in. high; floor space 6 ft. 2 in. x 2 ft. 7 in.; weight 28,000 lb.—**AVIATION, Dec., '44.**

Metal Cleaning Machines..... 63

New line of metal washing and drying equipment, announced by **Optimus Equipment Co.**, Matawan, N. J., consists of standard and special types. Standard models cover continuous horizontal flat conveyor for series of operations and variety of work; cabinet type washing and rinsing machine for parts handled in baskets; semi-automatic, in which parts are carried in drums, baskets, or racks, using hot blast dryer; automatic turntable, equipped for two or three operations on hollow parts or larger parts in baskets or holders. Special machines include continuous horizontal overhead chain conveyor for spray or dip; machine with one or two chains and cross bars for one or more spray or dip operations; continuous screw, or two-way rotating drum, fully automatic, for one or more treatment of large quantities of small

REFRIGERATION FOR ALUMINUM

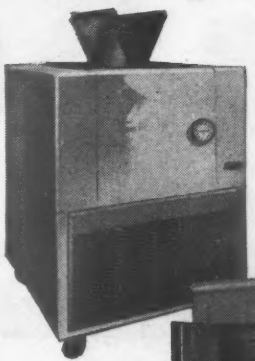


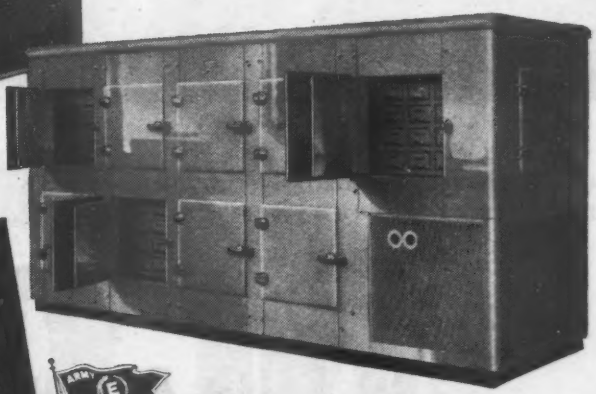
Heat treated aluminum rivets and sheets must be kept in a dead soft condition until used or fabricated. Heat treated aluminum age hardens very rapidly at atmospheric temperatures—becomes so brittle it can't be fabricated.

But if its temperature is promptly reduced to minus 40° F. and held at that temperature, the metal remains workable.

Kold-Hold has specialized in the engineering and manufacture of refrigeration equipment to keep heat treated aluminum dead soft. This includes the refrigerated quench, the refrigerated alcohol bath, the canisters for packaging rivets, storage cabinets and mobile cabinets to take rivets to the assembly line.

KOLD-HOLD MANUFACTURING CO.
442 NORTH GRAND AVENUE
LANSING 4, MICHIGAN

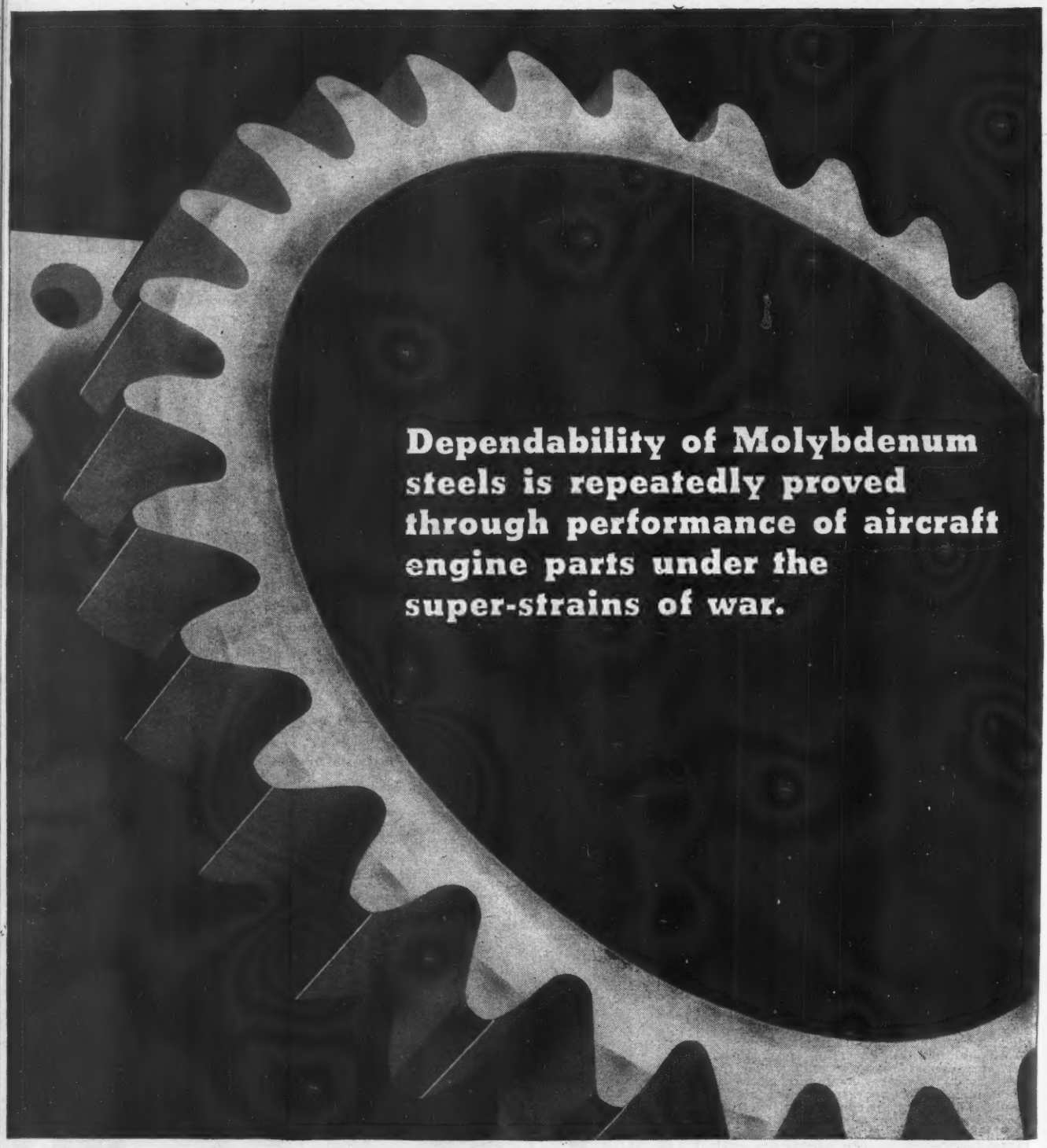




If you are working with aluminum, Write to KOLD-HOLD for CATALOG S-Z 431

ARMY E NAVY

KOLD-HOLD


Dependability of Molybdenum steels is repeatedly proved through performance of aircraft engine parts under the super-strains of war.

CLIMAX FURNISHES AUTHORITATIVE ENGINEERING DATA ON MOLYBDENUM APPLICATIONS.

ARMY E NAVY

MOLYBDIC OXIDE, BRIQUETTED OR CANNED • FERROMOLYBDENUM • "CALCIUM MOLYBDATE"

Climax Molybdenum Company

500 Fifth Avenue • New York City

MOLY

parts; and some special machines for roller bearings, aircraft parts, engines, compressors, and large castings.—AVIATION, Dec., '44.

Hydraulic Press 64

Called "Hydro-Squeeze Gun", new portable 1½-ton capacity hydraulic press with offset platen and ram, built for pressures up to 1,000 lb. psi., is announced by **Hydraulic Machinery, Inc.**, Dearborn, Mich. Employed on piston are "O" ring-

type seals. Ball-type switches control spring-returned 4-way valve. With both switch buttons pressed, valve solenoid is energized and oil under pressure is valved into gun, moving ram through 1½ in. stroke. Releasing one or both buttons de-energizes solenoid and ram starts return. Platen and ram accommodate special adapters. Standard power unit generates hydraulic power.—AVIATION, Dec., '44.

Shop Equipment & Materials

Photo-Layout Materials 65

Eastman Kodak Co., Rochester, N. Y., announces photo-layout materials for simplified method of printing working drawings directly on metal, consisting of layout paint and layout paint primer. Paint is sprayed on primed surface after cleaning. Drawing previously prepared with black ink on transparent or translu-

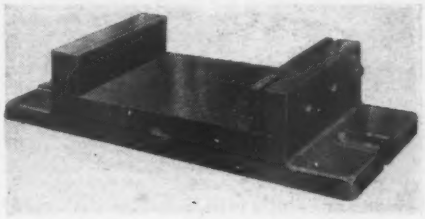
cent material is laid in contact with surface and exposure made to arc or mercury vapor lights. Drawing is removed and metal flooded with warm, weak ammonia water, followed by vigorous spray of tap water which washes away entire exposed coating, leaving only white lines. Final thin spray of primer protects finished product.—AVIATION, Dec., '44.

Dividing Head 66

Improvements in double-swivel dividing head manufactured by **Ellis-Lawyer Tool Co.**, Alhambra, Calif., are stated to include extra blank index plate which may be drilled for special operations, ground worm, and holddown bolts. Head has 6½ to 11 in. capacity swing; standard 1¾ in. 8-thread spindle ground to No. 9 B & S taper. Base is calibrated in deg. Three index plates are furnished, permitting all numbers up to 50, even numbers, and multiples of 5 to 100 except 96; also many others to 1000 and over. There is full revolution on horizontal plane and 100 deg. to right and 60 deg. to left on vertical plane.—AVIATION, Dec., '44.

Holding Fixture 67

Designed to cut down set-up and loading time on milling machines, boring



mills, planers, shapers, and drill presses, new holding fixture has been produced by **Challenge Machinery Co.**, Grand Haven, Mich. Unit is available in three sizes.—AVIATION, Dec., '44.

IT'S Here!
for the airlines of TOMORROW
Refueling AS FAST AS YOU WISH . . . WITH EASE AND SAFETY
ENGINEERS interested in faster refueling of aircraft and in generally more efficient fueling systems will find the new Wayne Collaps-a-Hose method interesting. Fueling rates of 150-200 GPM at low pressures are now readily obtainable. This means actual delivery into the plane through one hose. There will also be a Collaps-a-Hose System with delivery speed of 50-100 GPM available. In writing for booklet, please give us particulars of your own problem and what you desire to accomplish. There's no obligation.
THE WAYNE PUMP COMPANY, FORT WAYNE 4, INDIANA
Wayne Collaps-a-Hose
REFUELING SYSTEMS

Broach Holder 68

Recommending use of threaded broaches, **Zagar Tool Co.**, Cleveland, has developed new holder for this type broach that has removable threaded pads furnished in any standard pitch from 3/16 to 1-in. Holder is self-centering, can be adapted to fit any make of machine, and is stated to speed up operations. Given suitable pads, the holders can be furnished for either grooved or slotted broaches. In operation, handle is moved back 20 deg., allowing springs to open jaws. Pin closes jaws around broach when handle is returned to vertical.—**AVIATION, Dec., '44.**

Flooring Material 69

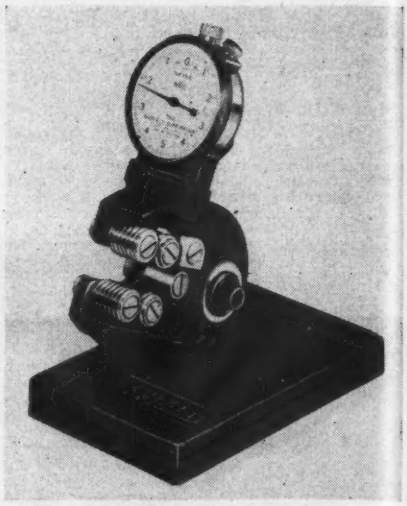
Stated to feel like rubber yet give long wear, "Stoneoleum", new flooring material made by **Continental Asbestos Refining Corp.**, New York City, is described as being "self-healing", in that small holes fill in and disappear under traffic.—**AVIATION, Dec., '44.**

X-Ray Measuring Instrument..... 70

New Geiger-Counter X-ray spectrometer utilizes Geiger-Muller tube to measure intensity and position of interference lines encountered in X-ray diffraction analysis work. Maker is **North American Philips, N. Y. C.**—**AVIATION, Dec., '44.**

Thread Gage 71

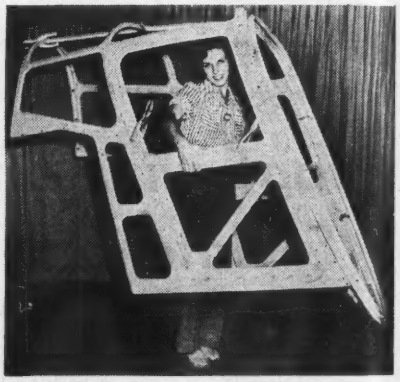
"Thredchek" is new type thread gage produced by **Sheffield Corp.**, Dayton, Ohio, described as incorporating principles of indicator snap and thread roll-snap gage. Instrument has large standard balanced type indicator graduated in .0001 in. and same "go" and "no-go" rolls as roll-snap gage; but top "no-go" roll is not fixed, and its movement is registered on indicator, showing pitch dia. Free rotating back-stop is stated to enable part to be properly located when presented to "no-go" rolls. If part passes "go" rolls, lead, thread angles, and pitch dia. are shown to be within tolerance



limits. Indication of pitch dia. when part is presented to "no-go" rolls separates check of pitch dia. from check of lead. If pitch dia. is correct, then lead is correct. Correctness of form or angle is checked visually. When part is rotated with "no-go" rolls, indicator shows any out-of-roundness.—**AVIATION, Dec., '44.**

Plastic Helicopter Structures..... 72

New plastic material developed by **United States Rubber Co.**, Mishawaka, **Ind., plant, is being used for cabin struc-**



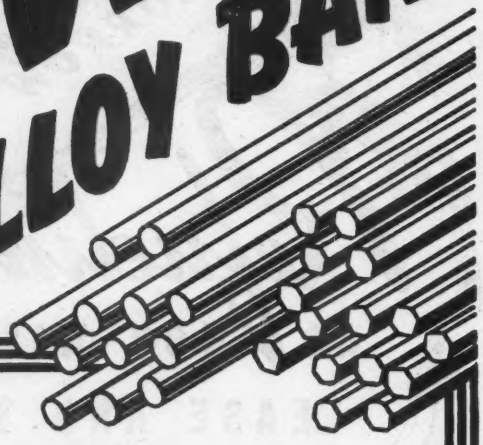
tures of helicopters. Made of Fiberglas, laminated and reinforced with thermosetting resin, it is stated to be of half weight of aluminum of same thickness and to have great strength and rigidity. —**AVIATION, Dec., '44.**

Impact Wrench 73

Operating with controlled torque, new ¼-in. impact wrench is offered by **Aro Equipment Co.**, Bryan, Ohio, Wrench operates forward and reverse and has calibrated adjusting screw on side to con-

trol tension. Control is obtained through roller clutch impacting mechanism, consisting of four parts. Length is 7⅛ in., spindle offset 1⅛ in., square drive ⅜ in., and weight 2⅞ lb.—**AVIATION, Dec., '44.**

ACW ALLOY BARS



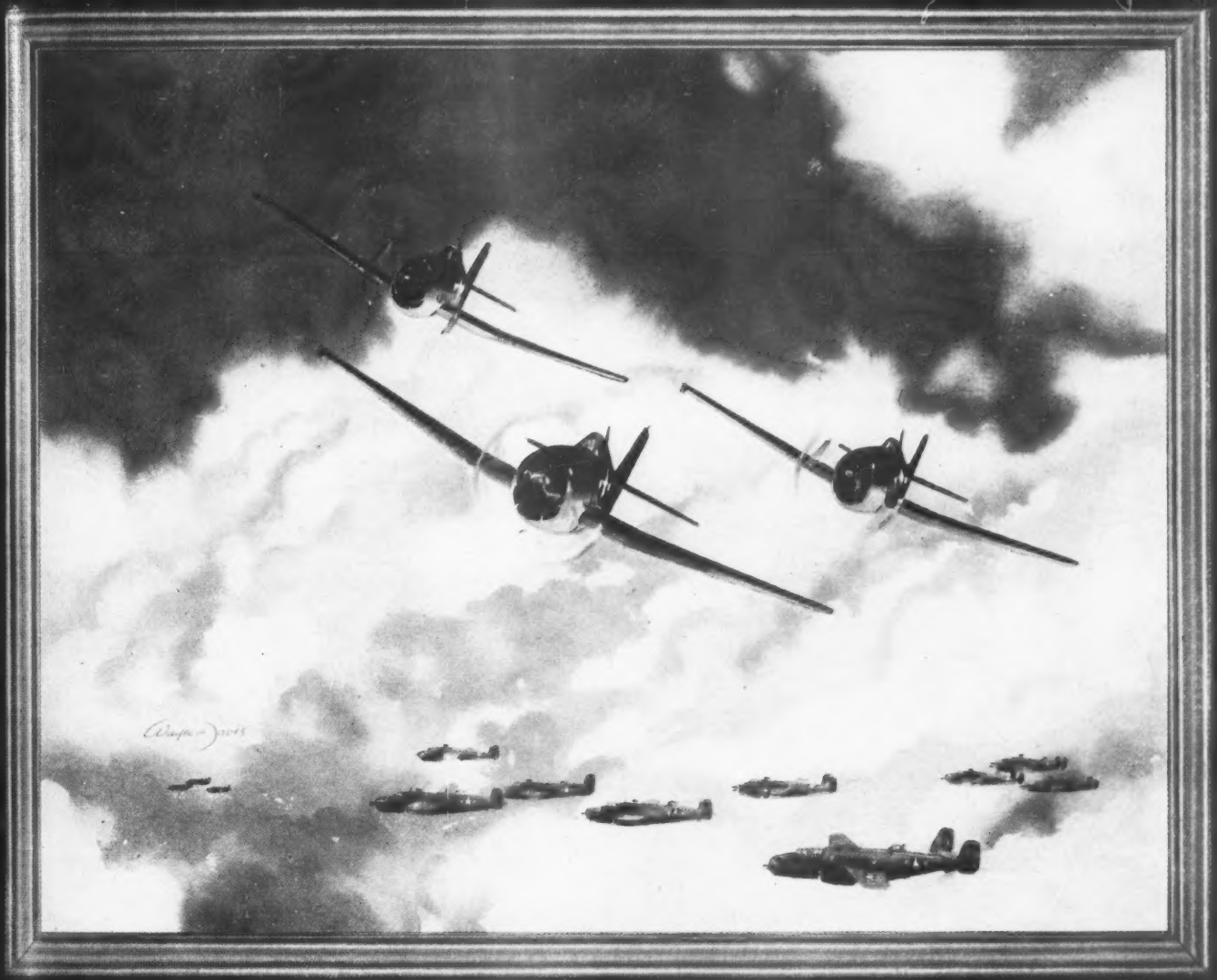
SHIPPED
AT A MOMENT'S NOTICE
FROM RYERSON STOCK

• Aircraft quality alloy steel bars—8630, X4130 and 4140—in a wide range of sizes, are in stock for immediate shipment from Ryerson plants at Chicago, St. Louis, Cincinnati and Jersey City. These steels conform to specifications: AN-S-14a, AN-QQ-S-684a, and AN-QQ-S-752 respectively and are readily available to aircraft manufacturers and their subcontractors under the ACW program. A booklet of stocks on hand, "Aircraft Alloy Steels," including condensed specifications for AMS and AN-S steels, will be sent on request.

Other steels at eleven Ryerson plants comprise over 10,000 different kinds, shapes and sizes. Call Ryerson first for quick action on steel.

Joseph T. Ryerson & Son, Inc., Plants at: Chicago, Milwaukee, St. Louis, Detroit, Cleveland, Cincinnati, Buffalo, Boston, Pittsburgh, Philadelphia, Jersey City

RYERSON STEEL-SERVICE



U. S Navy's Grumman Hellcats—Escorts of the Sky

Grumman

AIRCRAFT ENGINEERING CORPORATION, Bethpage, L. I., N. Y.

THAT OUR AIRCRAFT MIGHT *Master* THE ELEMENTS

WHAT'S THE PROBLEM? ***700 mile speeds? 70° below zero cold? 50,000 foot altitudes?***

A huge wind tunnel to test large models at speeds exceeding 700 mph! A high altitude chamber that duplicates the pressure and paralyzing cold of the stratosphere! A torture chamber where hydraulic tension jacks twist, wrack and punish an airplane more severely than flying conditions ever could!

With these and many other instruments of aeronautical science "worth a king's ransom," Curtiss-Wright's development and experimental engineers are mutually working toward mastery of the elements. As each triumph in these laboratories reflects itself in the skies, our nation will trade and travel by air with ever-increasing safety, comfort and speed.

Look to the sky, America! Curtiss-Wright Corporation, Airplane Division, Buffalo, New York.

Another Contribution of

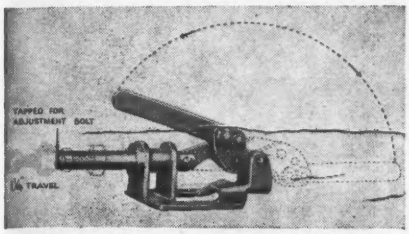
Curtiss-Wright

to the Advancement of Aviation

Member Aircraft War Production Council East Coast, Inc.

Push-Pull Lock Clamp..... 74

Described as specially suited for locating and indexing, new push-pull lock clamp No. 605, made by **Detroit Stamping Co.**, Detroit, has work end tapped to receive



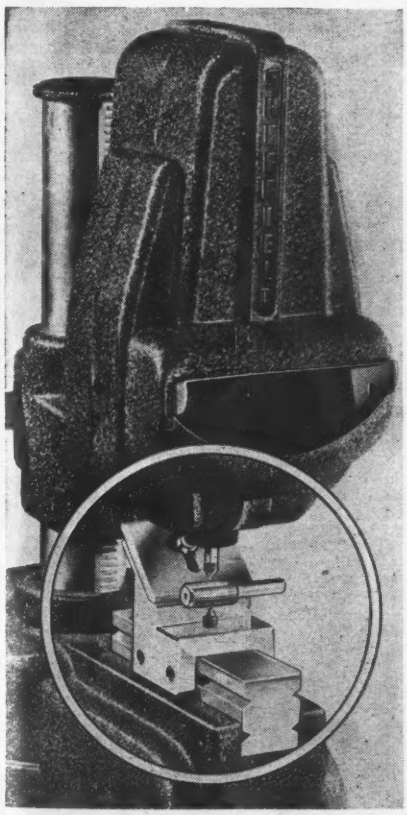
⅜ in.-18 standard threaded bolt which provides quick adjustment. Plunger rod travels 1¼ in. Conversion from push to pull is made by re-locating one handle bolt.—**AVIATION, Dec., '44.**

Tool Tipping Method..... 75

Eutectic Welding Alloys Co., New York, announces new method of tipping carbide and high speed steel tipped tools through use of two silver-copper and one copper alloy, now available in fine powder, into which flux is directly mixed. After degreasing and grinding, powdered alloy is spread on surfaces to be joined and carbide tip is placed on top. Assembly is heated until alloy melts. Each particle of molten alloy immediately "tins" and adheres to surfaces being joined.—**AVIATION, Dec., '44.**

Visual Gage Accessory..... 76

Sheffield Corp., Dayton, Ohio, announces standard ball accessory for company's visual gages designed for rapid and accurate checking of pitch dia. on threaded parts, and which may be used on 500-1 and 1000-1 models. Tool consists of chromed bracket and adjustable backstop with thread checking ball point of carbide mounted in bracket, and a second identical carbide ball point in spindle (see circled portion of illustration). It has capacity of 1 in. max. work dia. and is set up with threaded masters. Three pairs of ball points, stated to be equivalent to best wire sizes for 36, 20, and 12 threads per inch, are furnished. Threaded parts



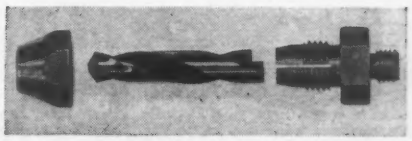
can range from 11 to 56 threads per inch, and up to 1-in. nominal size can be checked. Other sized points are available.—**AVIATION, Dec., '44.**

Grommet 77

Feature of new grommet for 4002 Series Camloc fastener is its design for use on all sheet thicknesses, thus new unit can replace seven different grommets previously needed for same range. Made of steel, it is permanently secured in panel, and pre-formed flange on outside is described as giving uniform strength characteristics. Maker is **Camloc Fastener Corp.**, New York City.—**AVIATION, Dec., '44.**

Drill Adapter 78

Salvage of broken drills is purpose of new positive-drive collet chuck drill adapter manufactured by **Zephyr Mfg. Co.**, Inglewood, Calif. Flat notch is rough ground on broken end of drill.



Notch slides past pin located at bottom of collet. Pin does driving; collet holds drill in alignment; and collet nut locks drill in place.—**AVIATION, Dec., '44.**

New Synthetic Rubber 79

"Dichlorostyrene" is new chemical compound from which heat resistant plastic or synthetic rubber may be made, and in plastic form it is stated to have both heat resistance and electrical insulating properties. Maker is **Mathieson Alkali Works**, New York City.—**AVIATION, Dec., '44.**

THE BEST IN MILITARY PYROTECHNICS

The needs of our air, naval and ground forces for military pyrotechnics are constantly changing to meet the fluid strategy of modern warfare. International's production of flare and signal equipment reflects these changing requirements, and our facilities have continued to meet the demands on them.

In addition, we are able to take care of our commercial customers whose requirements are supported by adequate priority ratings. We appreciate all opportunities to serve.

ARMY (E) NAVY

INTERNATIONAL FLARE-SIGNAL DIV.

of THE KILGORE MFG. CO. Tipp City, Ohio

Make the

CRITICAL ACCURACY

you build into your machines

EASY TO MAINTAIN

MOST EQUIPMENT MAKERS who utilize Laminum in accurately fitting gear mesh and bearings do so primarily to reduce precision machining. But the same shim also assures accuracy of future service adjustments... too important to overlook. Bulletin on request.

Laminum shims are cut to your specifications, but for maintenance work, shim materials are sold through industrial distributors.

Laminated Shim Company, Incorporated
80 Union Street • Glenbrook, Conn.

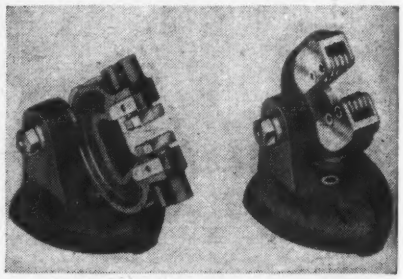
LAMINUM
TRADE MARK

THE SOLID SHIM THAT peels FOR ADJUSTMENT

2216

Snap Gage Tool Holder.....80

Described as accommodating any type snap gage, including all AGD frames and standard adjustable thread snap styles, new snap gage tool holder manufactured



by **Taft-Peirce Mfg. Co.**, Woonsocket, R. I., may be clamped at any angle.—**AVIATION, Dec., '44.**

Compound Die Cushion.....81

Dayton Rogers Mfg. Co., Minneapolis, announces compound pneumatic die cushion, made in three sizes, to meet the necessity of having two independent blank holders or draw ring holding pressures on same compound blanking, piercing, and drawing die.—**AVIATION, Dec., '44.**

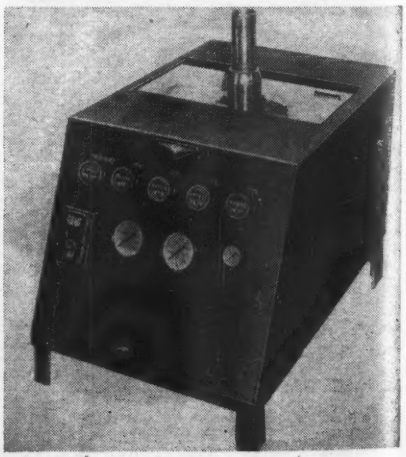
Vitrified Bonded Wheel.....82

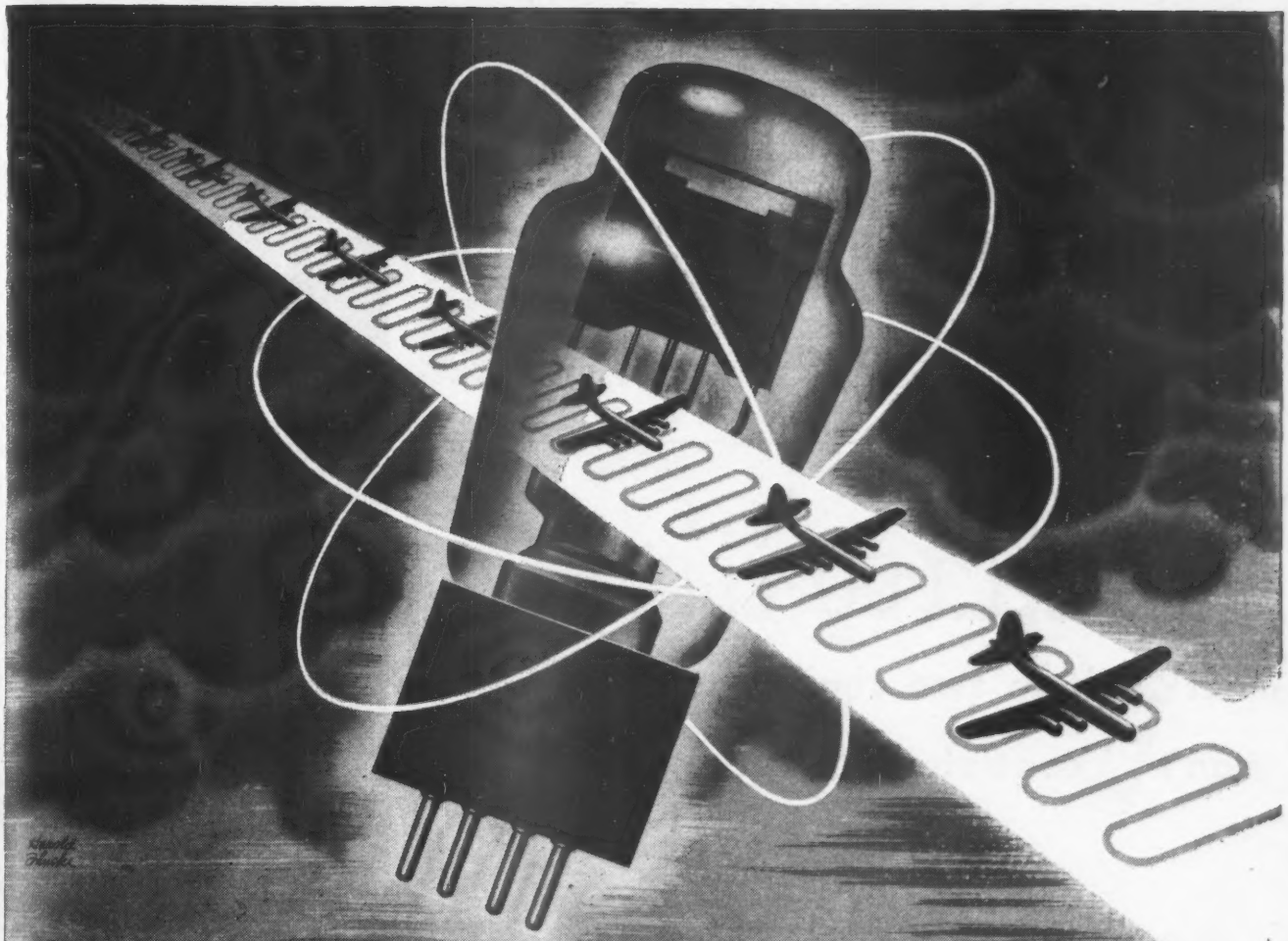
Feature of new vitrified bonded diamond wheel developed by **Norton Co.**, Worcester, Mass., is ability to offer com-

bination of fast cutting action with long life, along with capacity to hold sharp corner and postpone development of radii. Also reported is its ability to grind shank steel with least tendency to glaze or load.—**AVIATION, Dec., '44.**

Propeller Test Stand.....83

Tests for feathering, internal and external leakage, checking of distributor valve, etc., on Hamilton Standard Hydromatic propellers are made on new propeller test stand made by **Airplane Mfg. & Supply Corp.**, Glendale, Calif. Capacity and pressure are supplied by heavy duty 5 GPM. hydraulic pump driven by 2 hp. motor. Filter system is designed to protect pump and propeller, and vacuum gage indicates restrictions or line fouling. Two 4½-in. 0-800 psi. gages give readings, and operation is controlled by four valves, pressure by fifth valve. Standard power





Delco Radio Products Mean Fine Performance

From compact auto radio sets to highly intricate radio and electronic equipment for the armed forces, Delco Radio products are distinguished by fine performance. Each unit reflects care and competence in engineering; each part represents advanced techniques in production accuracy. Tomorrow's civilian needs, like today's military demands, will benefit from Delco Radio's engineering vision, manufacturing precision.

Delco Radio Division, General Motors Corporation, Kokomo, Indiana.

Put Your Dollars in Action—BUY MORE WAR BONDS

Delco Radio
DIVISION OF
GENERAL MOTORS

is 220-v. a.c. 3-phase 60-cycle. Length is 48 in., width 28 in., height 35 in., and weight 625 lb.—AVIATION, Dec., '44.

Vise-Wrench 84

Improvements in vise-wrench manufactured by **Knu-Vise, Inc.**, Detroit, are reported obtained by use of heat-treated

alloy steel forgings, with milled teeth welded to body which is also heat-treated. Wrench is available in 7 and 10 in. lengths.—AVIATION, Dec., '44.

Thermostat 85

In new built-in type thermostat produced by **George Ulanet Co.**, Newark, N. J., adjustment is stated to be simplified by elimination of lock nut. Adjustment screw passes through two collinear tapped holes on "U"-bent bracket, which imparts strong spring action on thread of adjustment and prevents its turning, except manually.—AVIATION, Dec., '44.

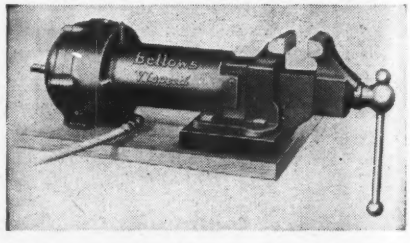
Flexible Metallic Packing.....86

"Inconel" is new type flexible metallic packing stated to be capable of withstanding temperatures up to 2,000 deg. F. and reported resistant to corrosive gases, alkalis and most acids. Adapted to use in exhaust systems of aircraft engines equipped with superchargers, it is described as absorbing vibration and preventing leakage. Packing is made of

nickel-chromium-iron alloy in wire form, knitted into mesh and braided. Packing is offered in various forms by **Johns-Manville**, New York City.—AVIATION, Dec., '44.

Pneumatic Vise.....87

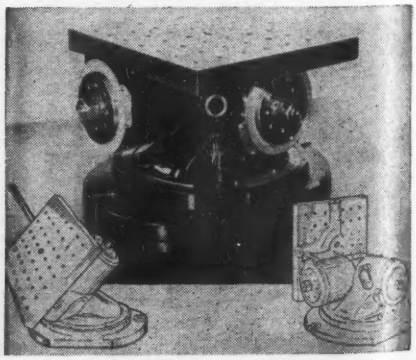
New unit consisting of 4-in. bench vise and 8-in. air cylinder, pressure regulator, gage, quick exhaust valve, air hose, and



foot pedal assembly, has been developed by **The Bellows Co.**, Akron. Called "Vi-speed", it has clamping pressure cap. to 2½ tons. Air unit may be purchased separately.—AVIATION, Dec., '44.

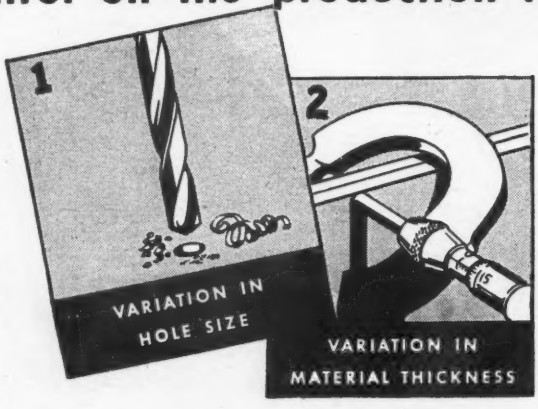
Compound Angle Plate.....88

Suitable for use on miller, shaper, planer, jig borer, and drill press, new compound angle plate, made by **Angle Computer Co.**, Los Angeles, is stated to enable operator to lay out machine and check work without removal from machine. It can also be used as 90-deg. angle plate on bench or machine. Plate holds work in any position from 0 to 90 deg. in two planes 90 deg. apart, and



Cherry Rivets

meet these two conditions which you can't control on the production line



Usually production conditions are NOT the same as drawing board specifications. Actual tests show that on the line as high as 60 percent of the holes drilled for rivets are .008" or more over nominal—due to improper handling of tools, dull drills or other causes.

Any rivet used under such conditions should have shank expansion great enough to take up that much play.

Accumulated tolerances in sheet thickness and gap between sheets may vary as much as .060" depending on the number of sheets being riveted. To securely fasten and make a tight joint a rivet must have wide grip length tolerance. This is especially important where blind rivets are used.

Cherry Rivets meet these two conditions —they have wider tolerance in hole size and grip length than any other blind rivets.

Read pages 14 and 15 of the Cherry Manual B-44 which show Cherry Rivet recommended tolerances in hole sizes and material thicknesses. A free copy will be sent on request. Address Department A-110, Cherry Rivet Company, 231 Winston Street, Los Angeles 13, California.

Cherry Rivet *Company*
LOS ANGELES, CALIFORNIA

CHERRY RIVETS, THEIR MANUFACTURE and APPLICATION ARE COVERED BY U. S. PATENTS ISSUED and PENDING.

in any position within 360 deg. of radial axis. Calibration is accomplished through use of protractors, two 5 in. and one 10 in. and each graduated to half deg., with vernier graduated to 1 min. and stated to have accuracy within 10 sec. of arc. Each plane has its own locking unit. There are 48 ⅜-16 tapped holes located 1½ in. apart for clamping work, also one ¾ in. reamed hole in line with radial axis of plate. Height is 8 in., length 14½ in., width 11½ in., and weight 155 lb.—AVIATION, Dec., '44.

Heating Torch **89**

Designed for concentrated localized heating, such as required for bending, straightening, and shrinking of steel plate, and for silver-brazing of heavy copper plate in manufacture of pipe, new heating torch with five new multi-flame propane heating tips and three mixers is announced by **Air Reduction Sales Co.**, New York City. Light weight is a feature.—AVIATION, Dec., '44.

Electrical Appliances

Circuit Breaker **90**

Westinghouse Electric & Mfg. Co., Pittsburgh, announces new 100 amp. "De-ion" circuit breaker described as requiring less space and permitting lighter structures for distribution panelboards, built-in applications, and bus duct plug-ins. All ratings are stated to be available in one breaker, with uniform pole spacings and terminal arrangement. New F-frame is stated to permit a 100-amp. 600v. a.c. or 250v. d.c. breaker is same space formerly occupied by breaker of 50 amp., 600v. rating. Included are thermal and instantaneous magnetic trip elements and silver alloy contacts. Both 2- and 3-pole units are available.—AVIATION, Dec., '44.

Aircraft Relay **91**

Stated to be non-positional and to operate consistently under vibration, new 115v. 400-cycle Type 20 aircraft relay is announced by **Automatic Electric Co.**, Chicago. Featured are high voltage coil insulation and protection against high humidity, temperature variations, and shock. Weighing 9 oz., relay is normally operated by control current, interruption of which releases relay and closes alarm circuit.—AVIATION, Dec., '44.

Circuit Breaker **92**

New No. 1560 (AN 3160) circuit breaker for aircraft, made by **Littelfuse, Inc.**, Chicago, is described as taking 350 deg. F. and 60 deg. F. below zero without breaking, due to new bi-metal design stated to eliminate appreciable mechanical load on bi-metal as it trips breaker. Range is 5 to 50 amp. at 32v., a.c. or d.c. It is reported capable of breaking 2,500 amp. on short circuit; to hold for one hour at 115 percent of rated current; to break within hour on 138 percent of rated current; and to break at 200 percent of its load between 10 and 100 sec. Unit is panel mounted by two 6/32 in. screws, ¼ in. long, for 1/16 in. panels equipped with heavy bus bars. It is 2⅛ x 2 in. deep below panel by ¾ in. wide. In

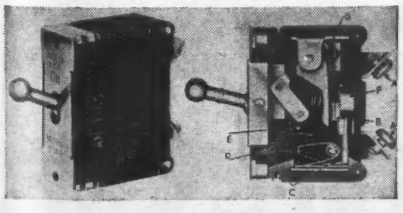


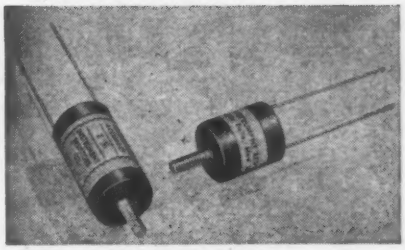
diagram of accompanying illustration, (A) shows terminals, (B) contact, (C) bi-metal finger, (D) Bakelite latch-block trigger, (E) latch, (F) permanent magnet, and (G) stranded copper cable.—AVIATION, Dec., '44.

Glass-To-Metal Seals **93**

Sprague Electric Co., North Adams, Mass., has developed new glass-to-metal seal for capacitors and resistors stated to guard against leaks and moisture. In capacitors, usual ceramic terminals are supplanted by glass bushings which are sealed direct to metal container without use of adjacent metal rings. In resistors, resistance unit is encased in glass tube, sealed directly to metal ends.—AVIATION, Dec., '44.

Resistors **94**

Instrument Resistors Co., Little Falls, N. J., announces new line of resistors designed for protection against deterioration in tropical or humid locations. Each component is enclosed in Bakelite case. After dehydration, resistor is sealed in special compound and case is closed with Bakelite cap. Leads are bare at point of entrance to case and are hermetically



sealed with special compound. After completion of the unit, a special non-toxic fungicidal coating is applied.—AVIATION, Dec., '44.

Battery Cable Terminal..... **95**

New battery cable terminal, stated to eliminate oxidation and prolong battery

All Ray-Ban Sun Glass production is allocated to military use.

KEEN-EYED SHOOTERS USE RAY-BANS

Wherever eyes are subjected to intense glare, in training or in combat, our fighters protect their vision with Ray-Bans. Long a favorite of sportsmen before the war, Ray-Bans cut glare-producing rays to a minimum. In bright sunlight, eyes are cool, relaxed and comfortable, vision is sharp and clear.

The workers of Bausch & Lomb are producing more Ray-Ban Sun Glasses than ever before—all to meet urgent military needs.

After Victory, civilians seeking visual comfort and glare protection will be able, once more, to purchase genuine Ray-Ban Sun Glasses and Shooting Glasses.

BAUSCH & LOMB
OPTICAL CO. • ROCHESTER, N. Y.

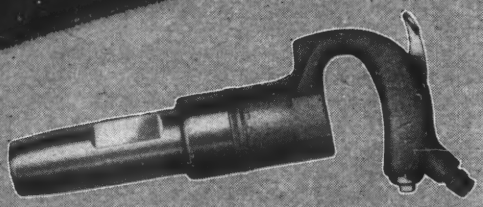
OFFICIAL PHOTO
U. S. ARMY
AIR FORCES

BAUSCH & LOMB IS DESIGNER AND PRODUCER OF BINOCULARS, SPOTTING SCOPES, RAY-BAN SUN GLASSES AND A COMPLETE LINE OF OPTICAL INSTRUMENTS

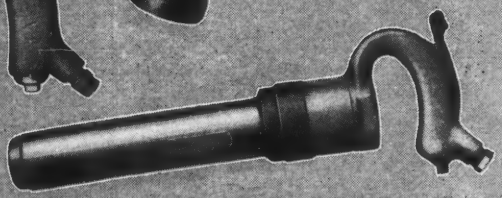
CLECO TOOLS

for PRESENT AND POSTWAR PRODUCTION

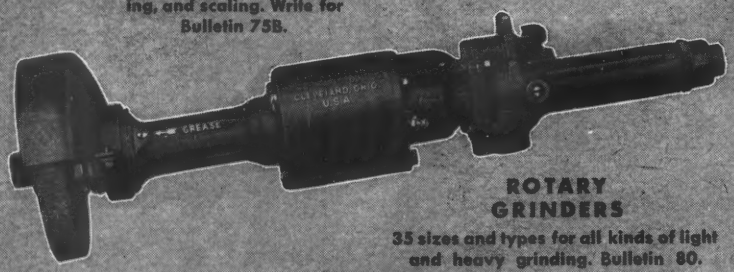
SAND RAMMERS
A model for every moulding job — for floor, flask, bench, and core work. Bulletin 76B.



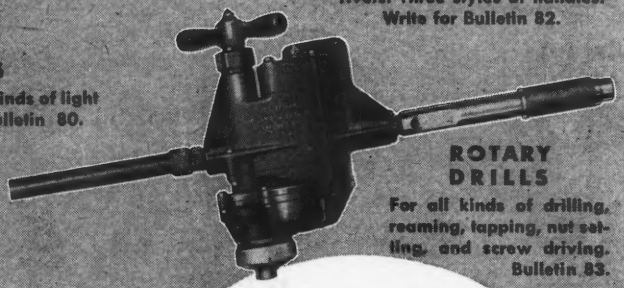
CHIPPING HAMMERS
47 sizes and styles for chipping, caulking, beading, and scaling. Write for Bulletin 75B.



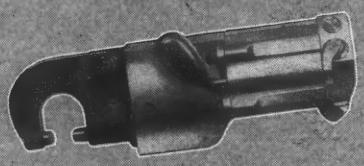
RIVETING HAMMERS
For heavy-duty work with hot rivets. Three styles of handles. Write for Bulletin 82.



ROTARY GRINDERS
35 sizes and types for all kinds of light and heavy grinding. Bulletin 80.



ROTARY DRILLS
For all kinds of drilling, reaming, tapping, nut setting, and screw driving. Bulletin 83.



SQUEEZERS
Model 41C, with "C" yoke, is a popular model among our squeeze riveters. Bulletin 85.

SHEET HOLDERS
Type "P", non-flying sheet holders clamp metal sheets together during riveting. Bulletin Type "P"

SMALL RIVETERS
For aircraft work. "Slow" and "fast" hitters, with many styles of handles. Bulletin 85.

With fast-working, air-saving Cleco Tools on the job, you will get top production now and for years to come. Every model among the wide variety of sizes and styles is backed by our half-century of experience in this field. Write for Bulletins.

THE CLEVELAND PNEUMATIC TOOL CO.

"PIONEERS FOR 50 YEARS"

CLEVELAND 5, OHIO • *Branch Offices in All Principal Cities*

life, is announced by **Leonard Mfg. Co.**, Los Angeles.—**AVIATION, Dec., '44.**

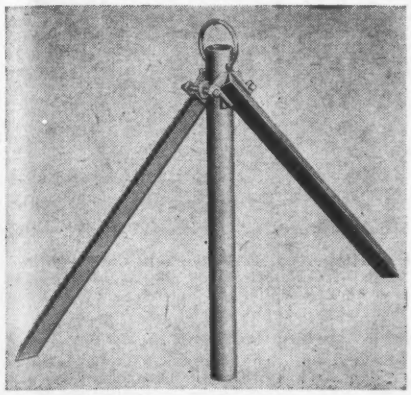
Midget Relay 96

Weighing 1.2 oz. and measuring 1 3/32 x 1 3/32 x 31/32 in., new single-pole single-throw relay is announced by **Guardian Electric Mfg. Co.**, Chicago. Operating on d.c. only, it is stated to have switch capacity of double-pole double-throw unit with 1.5 amp. contacts. Power requirement is 1.75w.—**AVIATION, Dec., '44.**

Aircraft Parts & Accessories

Aircraft Mooring Stake.....97

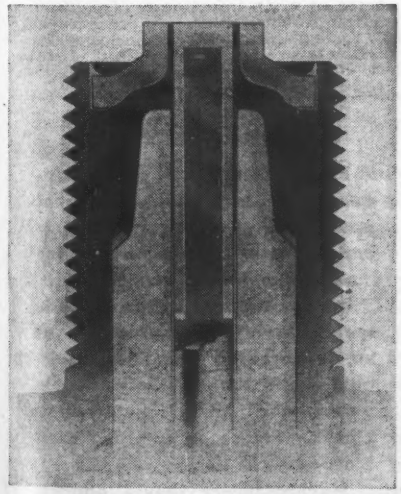
Adapting standard drive-anchor post foundation, **Anchor Post Fence Co.**, Baltimore, has devised new aircraft mooring stake. Stub piece of 2⅜ in. o.d. pipe 30



in. long with two shoes or clamps attached is driven full length into ground, exposing only ring. Next, removal of surrounding earth to depth of 4-in. exposes shoes, then two 1½ x 30 in. angle anchor blades are inserted through shoes at right angles to each other and driven in flush with shoe tops, after which earth is replaced. Anchors spread out under ground to width of 40 in. and tie downs are fastened to ring.—**AVIATION, Dec., '44.**

Aircraft Sparkplug 98

Electric Auto-Lite Co., Toledo, Ohio, announces improvement in aircraft sparkplugs stated to lengthen their life. Fea-



ture is center electrode composed of drawn nickel alloy cap into which is fitted and brazed a copper core, providing internal cooling.—**AVIATION, Dec., '44.**

You get more than "a bearing" when specifying McGILL "Solidend" MULTIROL. You get greater load capacity, provision for incidental thrust, bearing rigidity, high carbon chrome steel, and the elimination of end-washers and loose retaining rings. Thus, you are assured of a lower initial, operating and maintenance cost and at the same time an improved bearing performance.

For complete details and specifications of McGILL "Solidend" MULTIROL Bearings, send for bulletin SM-42.

BEARING DIVISION — 1950 N. Lafayette St.

McGILL MANUFACTURING COMPANY, INC.
VALPARAISO - INDIANA

"I'm too busy right now taking care of a BIG JOB for Uncle Sam, but when it's over and I come home to peace, I want to pick up those loose strings in Radio again. I've learned a lot serving with the Air Corps and that experience will come in handy when I return to my job in radio communications. But there's one thing I'm going to insist on, and that's MURDOCK Radio Phones — I'm mighty fond of their clearness and light weight— and I want that same cushioned comfort later on. Yes, sir!"

For 40 years MURDOCK precision engineering has been devoted to making the keenest ears in Radio. In War and Peace, MURDOCK means crystal clear and dependable communications.

Sub-Contracts Accepted

Though most of our facilities are devoted to government work, we can make more Radio Phones and related parts for you on a sub-contract basis. We'll be glad to help you.

RADIO PHONES

Here are some of MURDOCK'S Exclusive Features:

1 CUSHIONED COMFORT for long listening.

2 VENTILATED for ease and coolness — prevents condensation.

3 SUPER-SENSITIVITY for clear and accurate reception.

4 STURDY, SOLID-BUILT by precision methods—close tolerances.

5 TWO-WAY ADJUSTMENT to control position.

6 CONCEALED TERMINALS —plus long cords for easy movement.

Write for Catalogue

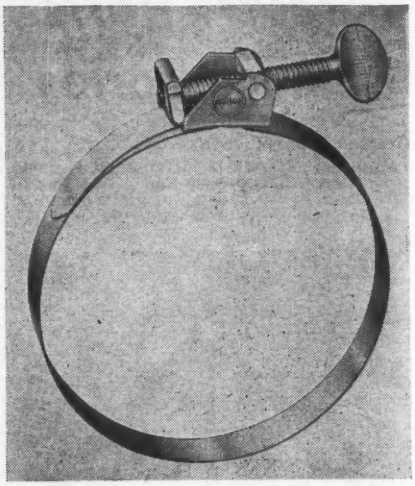
WM. J. MURDOCK CO.
121 Carter St., Chelsea 50, Mass.

Heavy Duty Brake Block.....99

Called "1492", new brake block developed for heavy bombers by Raybestos Div., Raybestos-Manhattan, Inc., Bridgeport, Conn., will shortly be available for general use states company.—AVIATION, Dec., '44.

Hose Clamp 100

Special construction features of new stainless-steel flexible-band-type hose clamp for aircraft use include swivel-action nut which rocks on swivel pins and tips down when thumb screw is tightened, cinching band. Made by Marman Products Co., Inglewood, Calif., clamp



is available in three sizes to cover entire range of AN 748 sizes 22 to 114 inclusive.—AVIATION, Dec., '44.

Supercharger Regulator 101

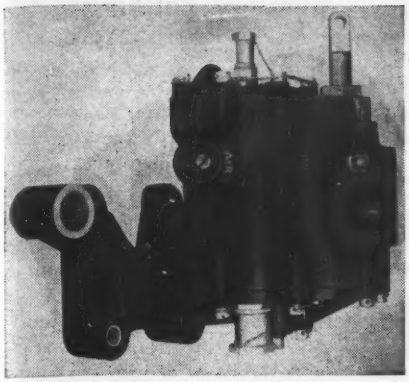
Developed by Eclipse-Pioneer Div., Bendix Aviation Corp., Teterboro, N. J., Type 581 supercharger regulators are designed to operate independently of carburetor throttle and to automatically control auxiliary stage of two-stage engine supercharger system to produce constant carburetor air inlet pressure. Carburetor inlet pressure is automatically held constant, at any altitude within rated limits of engine, by throttling inlet to auxiliary stage. Sensitive element, consisting of air pressure and evacuated bellows, measures inlet air pressure and functions continuously to prevent pressure from dropping or exceeding setting. Auxiliary stage inlet throttling valve is adjusted by an oil-actuated servo piston, regulated by valve connected to sensitive element. War emergency power is provided by bellows which resets supercharger regulator, during water injection, to higher value. Regulator is automatically reset to normal when supply of water is exhausted or when injection is discontinued. Bellows provides constant pressure control regardless of atmospheric pressure or temperature variations, and it is stated that lightweight bellows assembly re-

ANNOUNCEMENTS—

of new machine tools, shop equipment and materials, electrical appliances, and aircraft parts and accessories are invited for inclusion in these columns.

In writing, emphasis upon specific aviation applications of newly-marketed items is desirable, and whenever possible glossy-print photos should be enclosed. Please do not send electros.

Manufacturers should address New Products Editor, AVIATION, 330 W. 42nd St., New York City 18



duces acceleration loads. Balanced oil control valve provides oil regulation under pressure variations. Mounted on accessory drive section, regulators weigh 4.75 lb. Envelope dimensions are 7 13/16-in. wide x 5 5/8-in. deep x 6 11/16-in. high.—AVIATION, Dec., '44.

Tomorrow's Metal Designs

(*Continued from page* 177)

were turned out in 30 sec., whereas previous methods had required 2 hr. of machining.

F. deMarinis of S. K. Wellman Co., told of bonding thin plates of copper-alloy friction material to steel plates for aircraft brakes and clutches by coating with ferrous cobalt before bonding the powdered face at temperatures of from 1,200 to 1,500 deg. F. Composition of the powdered metal is about 73 percent copper, 14 percent lead, 7 percent tin, and 6 percent graphite. For the Goodyear type disk brake, the powdered ring of some 6-in. dia. with 0.75-in. face, called a "cookie," is only 0.010 thick. When sintered onto the steel disk it will operate against steel at 1,000 deg. F. and 1,000 psi. maximum, and is unaffected by oil or water.

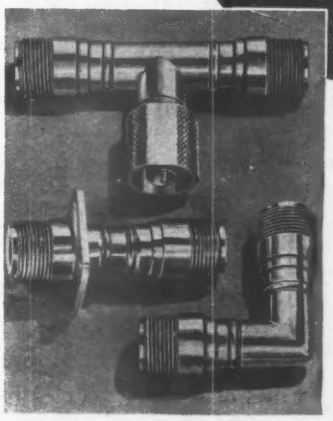
At the shot peening round-table discussion, L. E. Simon, chief metallurgist for Electro-Motive Div. of General Motors, declared that "we believe the method represents a useful production and engineering technique that must be considered in our designs for tomorrow." Advantages of shot peening were reported to include economy of labor and polishing time, increases in fatigue durability, and the possibility of a wider selection of materials, many of which may be lower-cost items. Two types of machines were demonstrated: The air blast and the centrifugal or airless, the latter stated by its producers to be less expensive to operate.

Induction heating equipment included three general classes: Motor-generators for lower frequencies, spark gap machines for intermediate and electronic tubes for the highest frequencies. In one full-scale exhibit the demonstration included case hardening of the teeth on a small aircraft engine clutch disk. The high frequency current is heated from 0.003 to 0.006 in. deep—accurately controlled—in 1 sec. prior to the water quench.

New inspection equipment of importance to the aircraft industry included the Supersonic Sperrytron, described by F. A. Firestone assistant professor of physics at the University of Michigan. In operation, oil is put on the surface of the piece to be checked, then a quartz crystal is placed on the surface and an electric current passed through the quartz. The latter vibrates, sending sound waves through the metal which are reflected back from the opposite surface. An oscilloscope records the action of these sound waves in such a manner that flaws can be quickly located. It is stated that penetration is 10 ft. and that the position of defects can easily be determined. Either ferrous or non-ferrous metals can be tested, and the units can be used on pieces already assembled, such as crankshafts and connecting rods.

Prof. A. V. de Forest of MIT reported that excellent results can be obtained with magnetic particles, which actually seek out flaws in steel parts, and with the new application of fluorescent particles which light up flaws.

Active Service
ON THE HOME FRONT



★ The efficient installation and operation of wartime radio and radar equipment depends in part upon Co-axial Radio Cable Connectors and the supply of these essential parts depends to a considerable extent upon The Astatic Corporation. This job keeps Astatic assembly lines busy day and night around the clock. Thousands of these precision-machined, carefully assembled, consistently uniform connectors, measuring up to highest government and manufacturer standards, are being shipped daily to leading radio and radar equipment manufacturers. In actual service, under the gruelling demands of wartime usage, Astatic Co-axial Radio Cable Connectors render most efficient and dependable service.

Astatic also supplies Microphones, Pickups and other important products and parts for communications and sound equipment.

THE Astatic CORPORATION
ASTATIC
CONNEAUT, OHIO
IN CANADA: CANADIAN ASTATIC LTD., TORONTO, ONTARIO

Where Dependability Counts
Permoflux Acoustical Devices Are Proving their Superiority!
Much of today's communication equipment is but remotely related to that in use when the war began. New Permoflux developments have meant increased efficiency for our fighting forces. The wide frequency response, extreme sensitivity and rugged mechanical design of Permoflux products have helped to achieve a standard of intelligibility heretofore unknown. Permoflux products will be available for many new post war applications.
TRADE MARK
PERM-O-FLUX
PERMOFLUX CORPORATION
4916-22 W. Grand Ave., Chicago 39, Ill.
PIONEER MANUFACTURERS OF PERMANENT MAGNET DYNAMIC TRANSDUCERS

Runway Building

(*Continued from page* 179)

90 percent of the AASHO. standard, designation T99–38. Actual compaction frequently runs in excess of 110 percent and will probably average more than 10 percent above specification requirements.

A field laboratory under the direction of the construction engineer is provided for quick determination of compaction and other physical tests required by the specifications.

From 6 to 12 in. of crusher-run base were placed over select sand and imported borrow. This material was laid down in two to three courses, depending upon the thickness. All crusher-run material was tested and has a required California Bearing Ratio of 80 percent or more. These tests are run on samples which were soaked four days and any material showing a swell of more than 1 percent after the four-day period was rejected.

The job involves a total of 103,500 cu. yd. of concrete paving. This is being placed in 25-ft. strips between steel headers, using three 34E Multi-Foot pavers, followed by a Blaw-Knox spreader equipped with a vibrating screen, a Viber full depth internal vibrating machine, and an Allan dowel setting machine. Behind the dowel machine the contractor has an apparatus of his own manufacture for cutting dummy joints, into which steel plates are inserted and left until the concrete attains sufficient set for their removal. The finish is accomplished with a Blaw-Knox vibrating finishing machine, followed by the final hand finish operation using wood floats and a burlap drag. Aggregate is hauled from Otay Valley and batched on the job.

Because this is the first runway construction specifying complete full depth internal vibration of the slab, the concrete placement on the project is receiving detailed study, and a series of exhaustive tests for both strength and density of concrete are being conducted.

Average concrete production to date has been 1,560 cu. yd. for a 10-hr. shift, ranging from a maximum of 2,258 yd. to 689 yd. for the high and low days.

The shoulders and intermediate area between runway and taxiway are being paved with asphaltic concrete varying in thickness from 3 to 5 in., depending upon surface conditions and anticipated load repetitions. The pavement subgrade is prepared with a prime coat of MD-1 liquid asphalt applied at the rate of ¼ gal. per sq. yd. of surface. Asphaltic concrete utilizes 50–60 penetration asphalt and an aggregate grading adapted to meet local conditions and maximum density.

Asphalt is placed at a temperature of

between 250 and 300 deg. F. Placing is by means of a Barber-Greene spreader and finishing machine. To assure a well sealed hot-joint, laying of strips is limited to a length of 400 ft. before starting the adjoining strip. A seal coat of emulsified asphalt is being applied, and this is followed by the application of a sand cover.

During the period of investigation and design the Navy was represented by Capt. A. K. Fogg, USN, (CEC) Public Works Officer of the 11th Naval District. During construction the Navy is represented by Lt. Comdr. R. D. Thorson, USNR, (CED), of the Bureau of Yards & Docks. Consolidated Vultee is represented by T. W. Van Derveer, plant engineer of the San Diego division, with John F. L. Bate assigned as Engineer-in-charge of construction for this project.

Shirt On a Star

(*Continued from page* 125)

ent planes, for example, is being converted into a "flying show-case" by removing the jump seat and installing special hangers on which the clothing can be displayed right at the airport, where a skeptical buyer might well be given his first flight. This first flight for buyers—skeptical and otherwise—has already been used very successfully.

Among other sales aids planned are deliveries by air in the company's planes of first shipments of Cavu merchandise into new territories, with the activities tied in, of course, with the local distributor's promotion program.

Although one of the main problems today is getting sufficient material and plant capacity to satisfy demand, the plane has already proved its practicability as a time saver by speeding selling trips.

Recently, for instance, M. M. Brohard and Ogden left Cincinnati at 10:30 a. m., flew to Indianapolis and Lafayette, spent a day and a half in Chicago, then went on to South Bend, Fort Wayne, and Muncie, and finally returned to home base at Cincinnati—all in three and a half days, selling to at least one distributor in each of the six cities visited.

"Frankly, we are amazed at the acceptance our clothes have had," Brohard told AVIATION. "We knew that tying in with flying had promotional possibilities, but we didn't realize they were as great possibilities as they are turning out to be. What's more important, though, is the fact that we can make such good, practical use of planes and pilots and thus help create employment in the aircraft industry as well as our own."

PACKARD
HIGH-ALTITUDE IGNITION CABLE
No. 530-E

It's not the engine alone, or the propeller biting at thin air, or the slow surge of the wing de-icers . . . it's all the little and big things together that *counts* when the altimeter hovers at the eight-mile mark. Everything must function—give that extra value that means the necessary speed and safety.

The ignition cable that "carries the current" *must not fail.* It must function in the bitter cold stratosphere and in tropical heat at sea level —must withstand sudden changes in temperature in plummeting power dives from ceiling to flight line.

Packard high-altitude ignition cable was developed to meet all extremes and conditions. Sheathed in tough synthetic rubber over an inner reinforcing braid, it effectively resists extreme heat and cold, moisture and electrical corona. More Packard cable is "in the air" than any other make.

Packard
REG. U. S. PAT. OFF. TRADE MARK

PACKARD ELECTRIC DIVISION
GENERAL MOTORS CORPORATION
WARREN, OHIO

ARMY E NAVY

PACKARD CABLE SERVES THE ARMED FORCES
on trucks • jeeps • tanks • armored cars • planes • aircraft instruments • anti-aircraft gun controls • landing boats • radio equipment.

A second star has been added for continued excellence

It's Not Yet Time to Break Ranks—KEEP BUYING WAR BONDS

Stocks Out of Bear Pit

(*Cotninued from page* 187)

net working capital per share and for less than their aggregate 1941–43 earnings before reserves. The firm's statisticians concluded that market prices for these shares "gives greater reflection to the unfavorable possibilities than it does to the favorable potentialities."

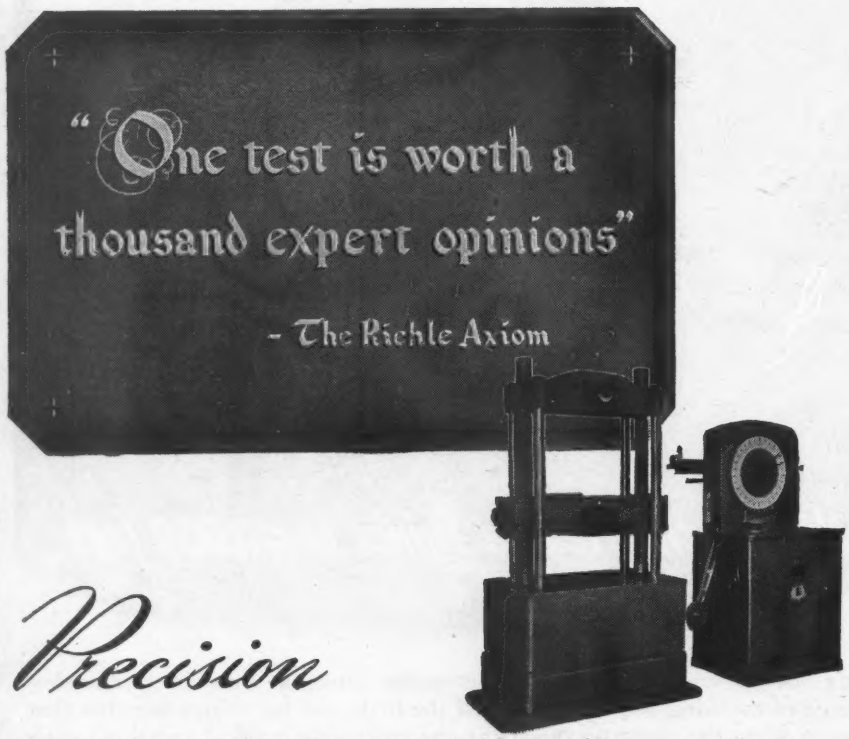
The dividend situation in the industry also is favorable. Dividend payments in the aggregate will run somewhat higher than in 1943, since a few companies have initiated dividend payments for the first time and several others have increased their total payments this year. Yet dividend policy throughout the industry has been conservative, and there is at least a possibility that some of the better situated companies will be able to continue dividend payments even through the postwar transitional period.

For the immediate outlook there also appear to be several favorable factors to consider. The war in Europe is continuing longer than was expected, and most experts still talk of the Pacific war in terms of years rather than months. Regretable though that surely is, it does mean that the transition to peacetime operation may be made in easier stages than previously appeared likely. It also is plainly evident that the automotive industry wants to get out of the aircraft business as rapidly as possible. Such a development would leave the aircraft industry to take care of needs for the Pacific war largely by itself. Thus the aircraft industry very possibly will have another year of wartime volume, though on a steadily declining scale. And at the same time it will have more leeway to prepare for peacetime operations.

As far as the long term outlook is concerned, there seems to be agreement only on one point: More planes will be in demand than in prewar years. Expanded air routes and a prosperous airline industry will provide larger transport orders than in the former peacetime years. It seems to be generally agreed than national defense needs alone will prevent the debacle in the industry that followed World War I. Predictions on the postwar size of the nation's air force run from S. Paul Johnston's 28,000 planes up to the 50,000 estimate by William A. M. Burden, assistant secretary of commerce.

Then there is the private plane. Predictions here run from 25,000 to 450,000 in the first five to ten years after the war. At any rate the Personal Aircraft Council of the Aeronautical Chamber of Commerce lists 28 companies that have personal plane plans in one stage or another.

And it seems highly significant of the growth possibilities in this industry that most aviation manufacturers are ready to stake their resources on new designs that will have to hold their own in highly competitive postwar markets. A year ago nearly all of these companies were actively searching for new non-aircraft products.



Precision

HYDRAULIC TESTING MACHINES

. . . . have repeatedly demonstrated the practical truth in the words, "One Test is Worth a Thousand Expert Opinions." Because they have simplified the science of testing the physical properties of materials they are widely used throughout the wartime industries today. Here Riehle Testing Machines "ferret out" material weaknesses and defects; avoid failures before they occur. This technique of progressive testing on the production line and in research laboratories saves valuable machine and man-hours. Write for descriptive literature and quotations.

Pendulum load indication is more accurate and dependable because it operates on the natural laws of gravitation. This principle of operation is not affected by temperature changes or subject to metal fatigue. .

ARMY E NAVY

RIEHLE *HYDRAULIC TESTING MACHINES*

Riehle Testing Machine Division, American Machine and Metals, Inc.
EAST MOLINE, ILLINOIS

Other Products: IMPACT TESTERS • VICKERS HARDNESS MACHINES
BRINELL HARDNESS TESTERS • MEASURING INSTRUMENTS

Contract Schools

(*Continued from page* 121)

people of the United States. The widely scattered location of the schools selected would have these benefits:

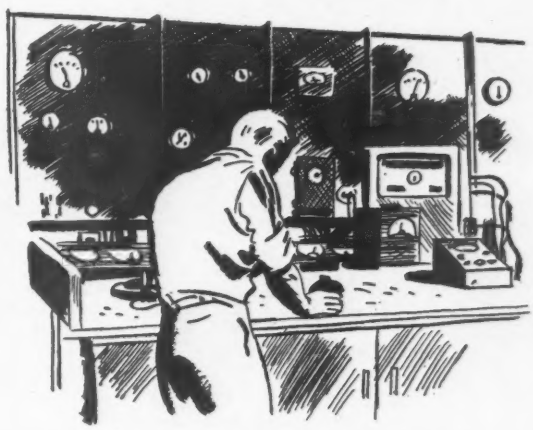
1. Training facilities would be provided reasonably close to the homes of the cadets, in turn reducing travel costs and contributing to high morale and keen public interest by making possible more frequent visits between cadets and their families.

2. It would spread the political and civic base of the program, bringing

THE ELECTRICAL LABORATORY

Electric Actuator Test. Here an actuator is tested under a 1980 lb. load at temperatures ranging from −65° F. to +160° F. AiResearch Actuators must move loads ranging from 35 lbs. to 10,000 lbs.—from a small cabin heater vent to a massive wing flap—under *all* conditions. Postwar aviation will be safer with AiResearch Actuators on the job.

Bell Jar Test. Altitudes up to 70,000 ft. can be simulated, with accurate recordings of humidity and temperature reactions. In this jar, electrical equipment that functions in both high and low altitudes is tested for thousands of hours. Through such research, improved equipment will be ready for postwar planes.



Electric Test Panel. Through this board 208 volt three phase, and 120 volt single phase, 400 cycle tests can be run – with variations in both voltages and frequencies. Here extensive work is done on Radio Noise, Explosion and Life Tests under simulated flight conditions . . . here safer flight is being created for the future.

In working out the problems of wartime flying, AiResearch is contributing to peacetime flight. AiResearch Manufacturing Company, Los Angeles and Phoenix.

"Where Controlled Air Does the Job" Automatic Exit Flap Control Systems • Temperature Control Systems • Engine Air Intercooling Systems • Cabin Pressure Regulating Systems • Supercharger Aftercooling Systems • Engine Oil Cooling Systems

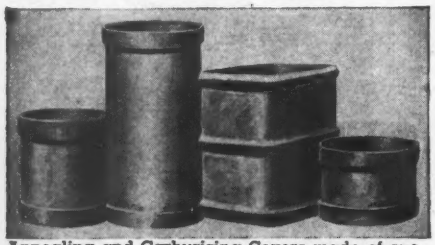
AiResearch
DIVISION OF
THE GARRETT CORPORATION

Experience Has No Substitute

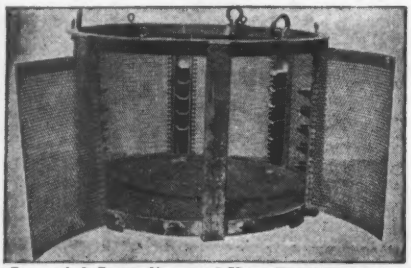
The finest in materials, engineering and experimentation go into every P. S. (for Pressed Steel) Carburizing and Heat Treating product. That's why P. S. equipment stands up longer under the severest operating conditions.

Throughout the aviation industry, P. S. has become the symbol of quality, service and reliability — for there are twenty years of hard earned experience in making P. S. high test industrial equipment.

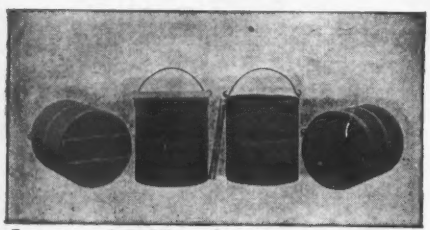
All P. S. products weigh less than ordinary cast iron products of the same capacity. That means greater efficiency, economy and easier installation.



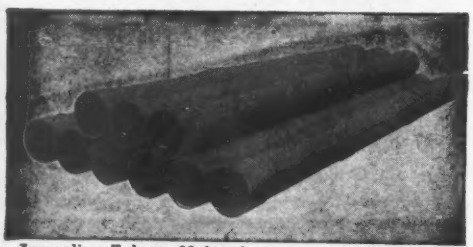
Annealing and Carburizing Covers made of special quality alloy steel. One-third the weight of equipment made in cast iron.



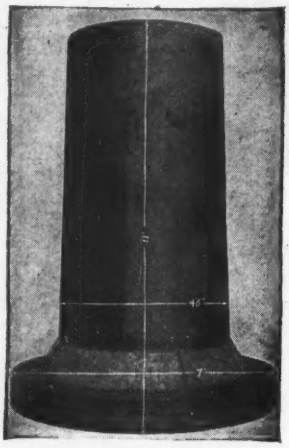
A special Annealing and Heat Treating Basket for general use in the aviation industry. Equipped with adjustable shelves and sides, this Basket is 6 feet in diameter, 6 feet high.



A group of Pickling, Dipping and Annealing Baskets. Furnished in any size with perforations to your specifications. Known everywhere for their high quality and accurate manufacture.



Annealing Tubes. 20 feet long, 20 inches in diameter. In high demand where the prevention of shutdowns is a must. Actual operating tests have proved their life to be 30 times longer than that of ordinary tubes.



Round Alloy Annealing Cover. Another Pressed Steel product available in any size, shape or specification.

Pickling Rack. Top cross members removable to assist in loading. Available in all sizes up to 10,000 lb. capacity.

BUY BONDS NOW!

The Pressed Steel Company

OF WILKES-BARRE, PENNSYLVANIA

BRANCH OFFICES

Broad St. Station Bldg., Philadelphia

312 Curtis Bldg., Detroit; 606 Nicholas Bldg., Toledo

1915 Engineers Bldg., Chicago; 51 E. 42nd St., New York

1005 Sterling Bldg., Houston, Texas; A & M Accessories Ltd., 19 Melinda St., Toronto

greater support and understanding from the people who must support it.

3. It would encourage more rapid development of civilian aviation through its constant reminder that flying is continuing and increasing. Each such school could become the aviation hub of its territory, constantly providing healthy stimulation to flying activities in its area.

4. The schools could provide facilities for the refresher and flying status maintenance courses the reserve pilots will require, closer to their homes, permitting reserve personnel an economical opportunity of maintaining flying status.

American history is filled with proof that proximity plays a vital part in public approval, and willingness to pay for, military expenditures. The Coasts have always favored a strong Navy. Communities and states with Army posts have never demanded that they be abandoned. And it is reasonable to expect that a strategically dispersed Air Force training plant would achieve similar understanding and support.

Would Assure Sound AAF

With nationwide support of this primary phase of civilian-military pilot training in the postwar military aviation program, its continuation on a sound basis would be assured. This, in turn, would backlog all other sections of the aviation industry, which is essential if the excellent USAAF is to avoid the decay which finally destroyed the French air force after World War I.

Economic gains and operational changes will inevitably result from the war. When Gen. Arnold cast aside military precedent and asked civilian operators to take over responsibility for the primary training of Army Air Forces cadets, it was probably considered by some to be a necessary, but possibly costly, temporary expedient. Instead, his vision has been fully justified by the high quality of cadet graduate, the unbelievably low accident rate, the extremely high graduation record, the tremendous saving in cost to the taxpayer, and the value to national security by the maintenance of this broadened and immediately available background of civilian aeronautical training bases.

The continued use of civilian schools for this military training appears to be a fortunate aid in the development of an essential postwar air arm on a satisfactory basis in accordance with the American way. Retention of this unique training method is obviously the best way of giving our Air Forces more support at less cost in dollars and manpower than could otherwise be obtained.

Handley Page Bid

(*Continued from page* 183)

The Hermes will be powered by four 14-cyl. sleeve-valve radial aircooled Bristol Hercules engines delivering a maximum of 1,600 hp. each, turning four-blade de Havilland hydromatic full feathering propellers.

Maximum speed is anticipated at 340 mph., weak-mixture maximum cruising speed is scheduled at 289, and long-range economical cruising speed is put at 240 mph. Wing tank fuel capacity is set at 2,750 imp. gal. (3,300 U. S. gal.), giving a maximum range of 2,000 mi. against normal headwinds.

Hermes design includes four cargo, mail, and baggage compartments, with total capacity of 630 cu. ft.

Service Brings Business

(*Continued from page* 195)

go miles out of their way for this kind of service is proper handling of ships when they land. Too often one taxis all around the field and hangar line before anyone comes out to direct parking or show where the gas pit is located. The net result is this: The transient finally stops his engine only to find he's several hundred yards from the gas pit or in the way of airplanes being wheeled out of the hangar. This means more work for hangar attendants to move the transient ship and additional delay to the pilot if he's in a hurry to get service and be gone.

At Jennings Airport, line attendants are on the alert for landing airplanes. Before the pilot has completed his landing roll and has started taxiing toward the line, he sees a lineman with a checkered flag.

The black and white flag, standard Army signal for directing parking, indicates that the pilot should come to the man holding the flag and follow his instructions. The Jennings lineman designates a spot for the transient to park and stands in front of the left wing (on the pilot's side) to direct actual parking. Before the pilot stops his engine, his servicing needs are ascertained and, if gas is required, he is directed to the gas pit. All ships are tied down immediately, assuring visiting pilots protection for their ships if the wind comes up while they're in town.

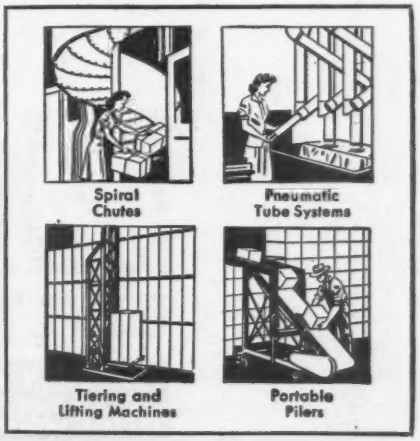
To give proper attention to all aircraft a loud outside bell is rung by the office girl. One long ring indicates the arrival of an airplane and calls linemen, who may be in the hangar, to come to the line. Local ships are also handled in this manner on the assumption that any inexperienced students should be watched closely while taxiing near

The costs of material handling are known to be excessive—they add to the price of the finished product but contribute nothing to its sales value. Cut these costs and you gain a tremendously important competitive advantage.

Conveyors and conveyor systems, adapted to your particular operations, speed up material and commodity handling activities, pull handling costs down to an economical level, speed the flow and movements of production. Conveyors handle a wide range of commodities — parts, packages, units, cartons, cans, bottles, barrels, bundles, drums, boxes. They are built in light, average, or heavy-duty types for either portable or stationary use—in a wide variety of sizes, styles and lengths.

Standard builds roller, belt, chain, slat, push bar conveyors; spiral chutes, tiering and lifting machines, portable pilers, and pneumatic tube systems, for every type of material handling and is equipped by experience and facilities to reduce your handling costs with the right type of equipment. Get the profitable answer to your material handling problem today. Write us for Bulletin No. A-124

STANDARD CONVEYOR CO.
General Offices: North St. Paul, Minn.
Sales and Service in Principal Cities



parked airplanes. Due largely to this system there have been no taxiing accidents or collisions at Jennings.

As a result of improved operations, coupled with a moderate advertising and promotion campaign through local papers, a steady increase in student business has been witnessed. Students have been derived from a number of different categories. Many have been younger boys, about to enlist in aviation cadet training, whose parents were anxious to have them receive a little advance time in the fundamentals of flight. Just recently nearly 20 cadets from Carlisle Military Academy at Bamberg, S. C., started 8-hr. solo courses under academy supervision. Energetic Manager Crocker has also helped organize a club at the local high school, and many boys and girls from this organization are expected to start flying soon.

Many students are business men and other substantial local citizens who contemplate owning their own postwar airplanes and are preparing for personal flying by getting their licenses now. Hawthorne's advertising has featured this type of training. The result has been that a number of them have already bought used airplanes.

Typical owners at Orangeburg are Gus Browning, a Luscombe owner, who runs a local radio store; Louis Pearson, superintendent of the water works, who owns a Taylorcraft; Tom Summers, a Taylorcraft owner and jewelry store operator; J. T. Green, nearby theater manager and owner of a Stinson Voyager; and others.

The increase in airplanes at Jennings caused an immediate shortage of hangar space. The regular hangar, holding around ten ships, was soon overcrowded. Five portable, individual tee hangars were purchased in New Jersey, shipped to Orangeburg, and erected west of the main hangar, setting a logical pattern for any small or large municipal airport.

This is the principle of having a main hangar for storage of planes in every-day use (such as the operator's training ships), with construction of individual hangars for private planes used occasionally by their owners. Hawthorne contemplates putting up additional hangars as materials are available, realizing that they represent an excellent source of revenue.

Efficient use of available land was accomplished by laying out the tee hangars in the form of a "U". With the exception of the interlocking tee hangars, this layout is most economical of available land. Storage rates charged for hangar space at Jennings are $15 for planes of three places or less and $22.50 for larger craft. No premium is charged for individual hangars.

The increase in aircraft has brought about a brisk shop business. Headed by A. C. Oxner, three full-time mechanics are kept busy doing work on local ships and planes from near-by points. The hangar includes a small shop, large enough for re-cover work, and recently a 20 x 40-ft. lean-to has been added to the west side of the hangar. Large enough for a complete airplane up to the size of a Waco, this lean-to facilitates work on engines and aircraft since the plane being worked on is not subject to constant moving when other planes are brought in and out of the main hangar.

Consistent with maintenance needs, shop equipment has been enlarged. Some of the essential tools and machines needed for small airport maintenance found at Jennings are a late-type Sioux valve-grinding machine, a large air compressor for spraying, a large drill press, a magneto testing machine, magnet charger, and welding equipment.

As with any other wartime business, the manpower situation has brought headaches to Jennings. Probably the only unique advantage enjoyed over other small wartime airports is a working arrangement for instructors from

ACCURACY

The surgeon's deft hand is clumsy in comparison with the exacting requirements of Milford's shop standards.

The building of precision fasteners for Uncle Sam's aircraft, exactly to specification—accurately, smoothly finished and delivered on time—has resulted in a vastly increased capacity for accurate service in the peace-time production of rivets, Phillips recessed-head screws, and other fastening devices in which MILFORD specializes.

Accurate FASTENING SERVICE is also your privilege, whether or not MILFORD be your source of supply for fastening devices. We are always interested in working with "hard to satisfy" people.

The MILFORD RIVET & MACHINE CO.

EASTERN DIVISION — CENTRAL DIVISION
MILFORD, CONN. ★ ELYRIA, OHIO.

Gen. Eisenhower Meets the Press

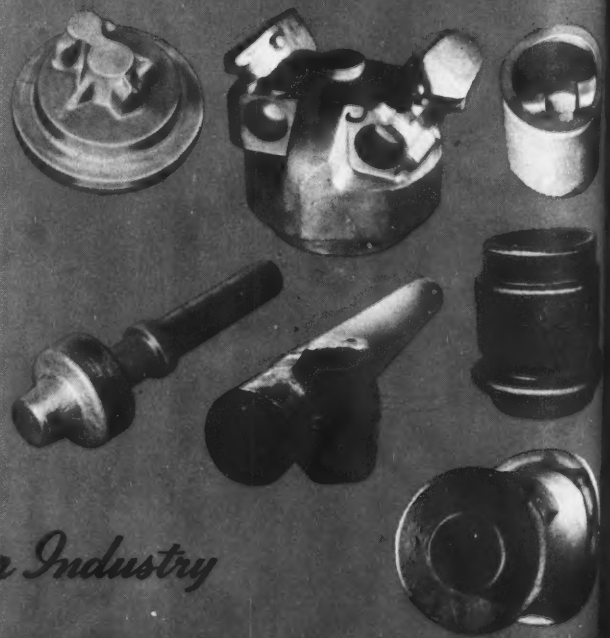
"I'M GETTING TUBE TURNS' OPINION ON ITS FORGE-ABILITY"

Perhaps *you* have a part or product that forging would improve . . . or a present forging job that could be bettered in precision, cost or service.

We welcome opportunities to tackle difficult upset or press forgings, in either steel or light metals. At Tube Turns you'll find a stimulating kind of cooperation — in which practical forging skill and engineering knowledge are accented by resourceful thinking and original techniques. You'll find laboratories that offer virtually every modern method for mechanical, chemical and electrical research and testing. You'll find ample production facilities for volume output plus exacting accuracy — upsetters and presses in sizes up to the largest, heat treating furnaces of the most recent types and one of the largest die shops in the country.

That's why you often hear it said, "I'm getting Tube Turns' opinion" . . . and its sequel, "We're giving Tube Turns the job."—TUBE TURNS (Inc.), Louisville 1, Ky.

DO ANY OF THESE STEEL AND ALUMINUM FORGINGS BY TUBE TURNS GIVE YOU IDEAS?



TUBE TURNS *Forgings for Industry*

the Army primary school operated by Hawthorne. The Army program calls for instructors to fly from 8:00 a.m. to 1:00 p.m. one week and from 1:00 p.m. to 6:30 p.m. the alternate week.

Men with previous operating and business experience have been selected from the Army school to handle student work and general flying at Jennings during the half day when they are not flying Army students. These instructors are Edward F. Slaughter, who ran his own textile machinery business in Charlotte, N. C., before the war, and F. Sibley Law, a textile manufacturing executive from Spartanburg, S. C. "Bud" Crocker, Airmotive's manager, was formerly an Army instructor, and before the war he spent eight years managing one of the largest drug stores in Toledo, Ohio. He was also a professional golfer.

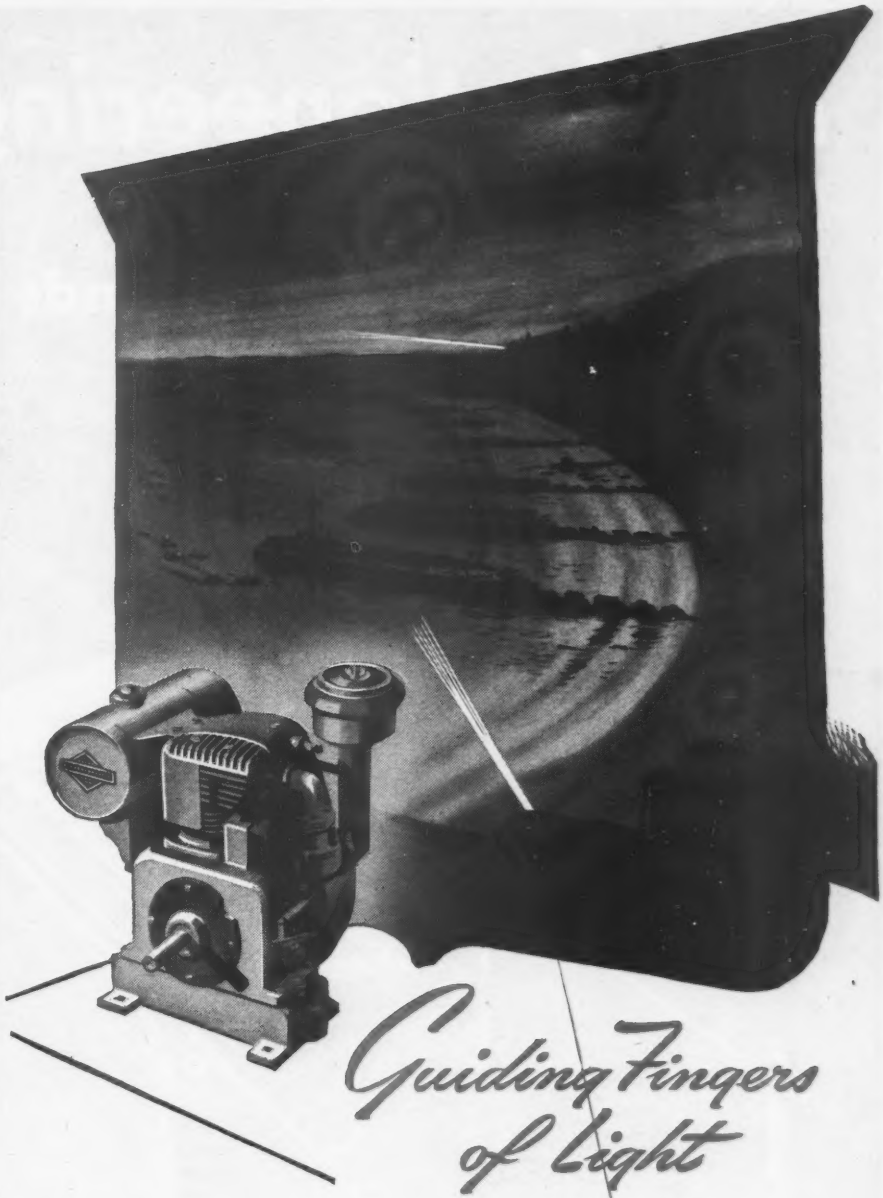
A check of the other personnel at Jennings, and a consideration of their duties, affords a representative picture of organizational requirements at a small airport capable of adequately handling nearly two dozen permanently based aircraft and an increasing number of transient ships.

Two girls working in alternate shifts are employed in the office. This is one phase of the operation which is often overlooked. These girls are on duty continuously from 8 in the morning until flying stops at sunset. They handle the phone, cash, billings, student records, and other general bookkeeping and office work. Their presence is considered essential by Manager Crocker since they relieve him and other pilot personnel from much of the detail work of accounting and handling cash and records. The girls see to it also that visitors are received properly and handled courteously and that the phone does not go unanswered, a sure cause of scaring away business at most airports.

The line crew is recruited from high school boys interested in flying. Normally four linemen are on duty at all times. Attired in standard Hawthorne coveralls, they present a neat appearance. They are drilled to serve, both properly and courteously, all plane owners, students, and transients.

Development of facilities has been accomplished on a what-the-business-can-afford basis. From the start, new equipment and additions have been added only as prospective and existing business warranted. In no way has the large backing of the Hawthorne organization supported operations at Jennings—in short, no "angel" has pumped in money.

One of the most striking and important improvements made under this policy has been construction of a very inexpensive porch at the operations



Guiding Fingers of Light

From newly established positions, portable beacon units guide and warn supporting ships and aircraft. Their electric generating plants are powered by rugged, quick-starting Briggs & Stratton engines — another one of many vital war services by hundreds of thousands of Briggs & Stratton engines.

Air-Cooled Power

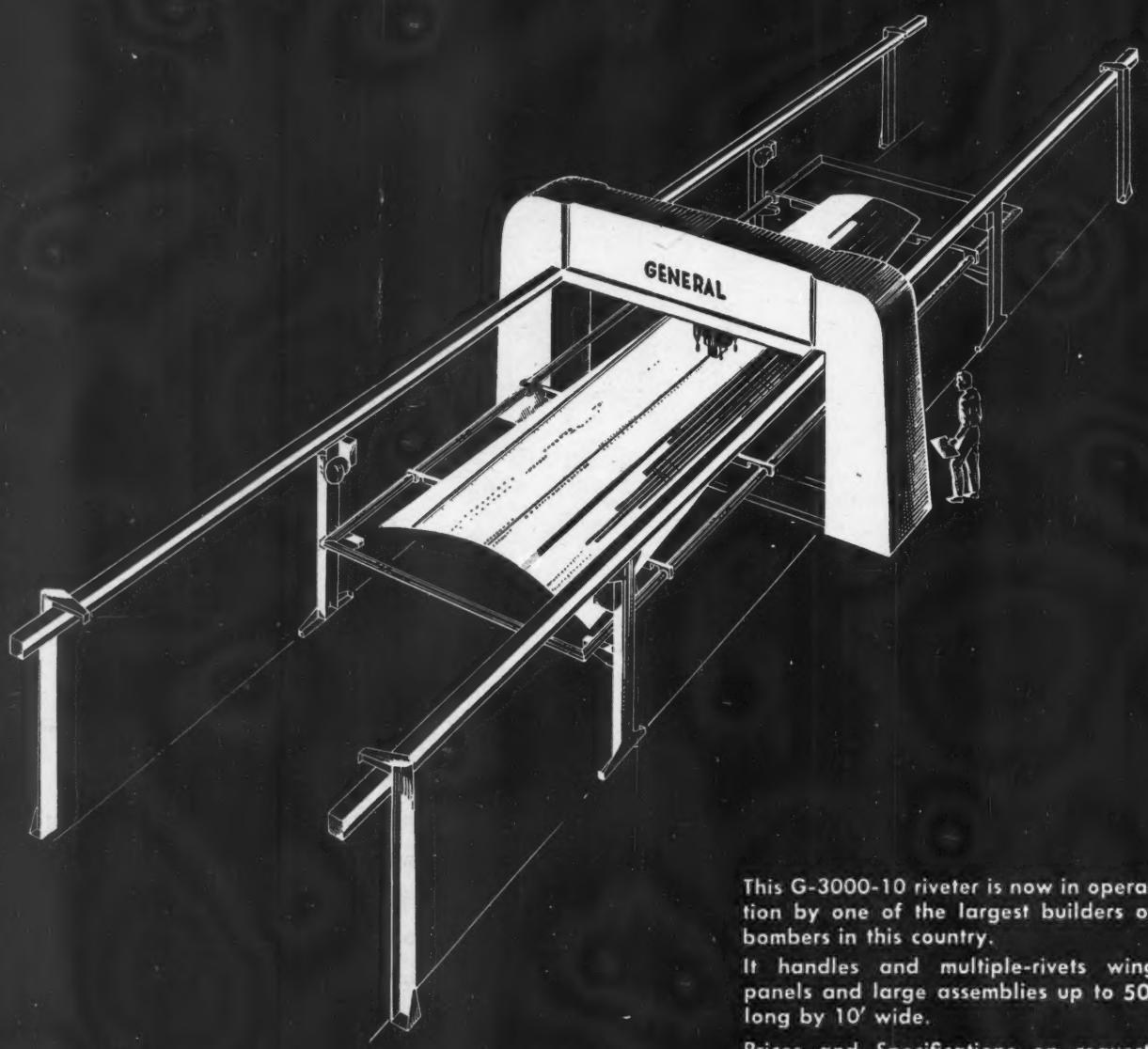
4 CYCLE BRIGGS & STRATTON GASOLINE ENGINES

BRIGGS & STRATTON leadership in design, engineering and precision manufacture is backed by the performance record of more than TWO MILLION Briggs & Stratton engines—and a quarter-century of *continuous* production of *"air-cooled power."* You can profit by this experience in your plans for the future—whether you manufacture, sell or use gasoline-powered equipment or appliances. BRIGGS & STRATTON CORP., Milwaukee 1, Wisconsin, U. S. A.

Productioneering —

by "GENERAL"

saves thousands of man-hours



This G-3000-10 riveter is now in operation by one of the largest builders of bombers in this country.

It handles and multiple-rivets wing panels and large assemblies up to 50' long by 10' wide.

Prices and Specifications on request.

GENERAL ENGINEERING CO.

785 Hertel Avenue Buffalo 7, N. Y.

Single, Multiple and Automatic Multiple Riveters

Work Handling Equipment

Special Machinery

hut. At a total cost of less than $50, this addition, measuring 20 by 10 ft. has added materially to the hangar-lounging facilities. A number of comfortable porch chairs were installed on a flooring made up of crushed gravel.

"We can definitely see, in actual dollars and cents," says Crocker, "profits from the construction of this porch. Quite a few people are spending their evenings and Sundays enjoying the shade of this facility and watching the airplanes. As a result, many have started flying because they have been exposed to it in a comfortable manner, have talked with friends who have just taken a lesson, and have, thereby, become interested. In many respects our little porch is becoming quite a meeting place and bull-session center for flying enthusiasts."

Expansion of both office and inside lounge facilities, somewhat along the line of the airport country club idea suggested by the author in "More Fun at the Airport" (Dec. 1940 AVIATION), is contemplated when further construction is possible.

Neatness of premises, always a fetish of Beverly Howard, is predominant at Jennings. Borrowing from Army procedure, neat metal sand-filled receptacles, about 1½ ft. sq., are placed at strategic points to receive cigarette butts, scrap paper, etc. The grounds are policed regularly by linemen.

Recognizing the fact that transient pilots appreciate a snack and a "coke," the office stocks crackers, sandwiches, soft drinks, and cigarettes. This also agrees with local residents who, in true South Carolina tradition, won't linger anywhere very long if they can't get a coke. More important, though, this service has developed as a reasonable source of revenue, for weekly sales average around $75. A small show case in the office displays log books, accessories, and a stock of some of the most commonly needed light plane parts. Hawthorne Airmotive is also a retail outlet for Hawthorne Aero Supply, a new aeronautical supply house. A full file of aeronautical charts are available as well.

Flight equipment currently operated includes two Piper Cubs, a Porterfield, and two Taylorcrafts. Rates charged are $6 solo and $9 dual. A 450-hp. Beechcraft, owned by Beverly Howard, is available for charter business, a fair amount of which has been booked.

In addition to these ships, planes stored at Jennings include four Wacos, four Cubs, two Aeroncas, two Taylorcrafts, a Luscombe, a Monocoupe, a Stinson, a Stearman, and a Bowlus sailplane.

Traffic is handled on a standard

TOUGH going in tanks necessitated a radio relay that wouldn't be knocked "slap-happy" by vibration and shock. The BK-13 is such a relay. It protects receiving sets when the transmitter is operating by shorting receiver antennae to the ground. In it, Callite Silver Contacts provide a long-wearing resistance path. The Parker Engineering Products Company of New York chose our contacts for this important job.

Callite offers you highly specialized experience in selecting contacts. It will pay you to have our recommendations in planning post-war products. Callite Contacts include standard and special shapes in tungsten, molybdenum, silver, platinum, palladium and alloys of these metals. Send for Contact Catalog No. 152. Callite Tungsten Corporation, 545 Thirty-ninth St., Union City N. J. Branch Offices: Chicago, Cleveland.

Callite CONTACTS

FORMED for a FUTURE
From spring material selected for quality and suitability under extremes of atmospheric or corrosive conditions.
RAYMOND SPRINGS
WIRE FORMS — SMALL STAMPINGS
RAYMOND MFG. CO. DIVISION OF ASSOCIATED SPRING CORPORATION CORRY, PA.

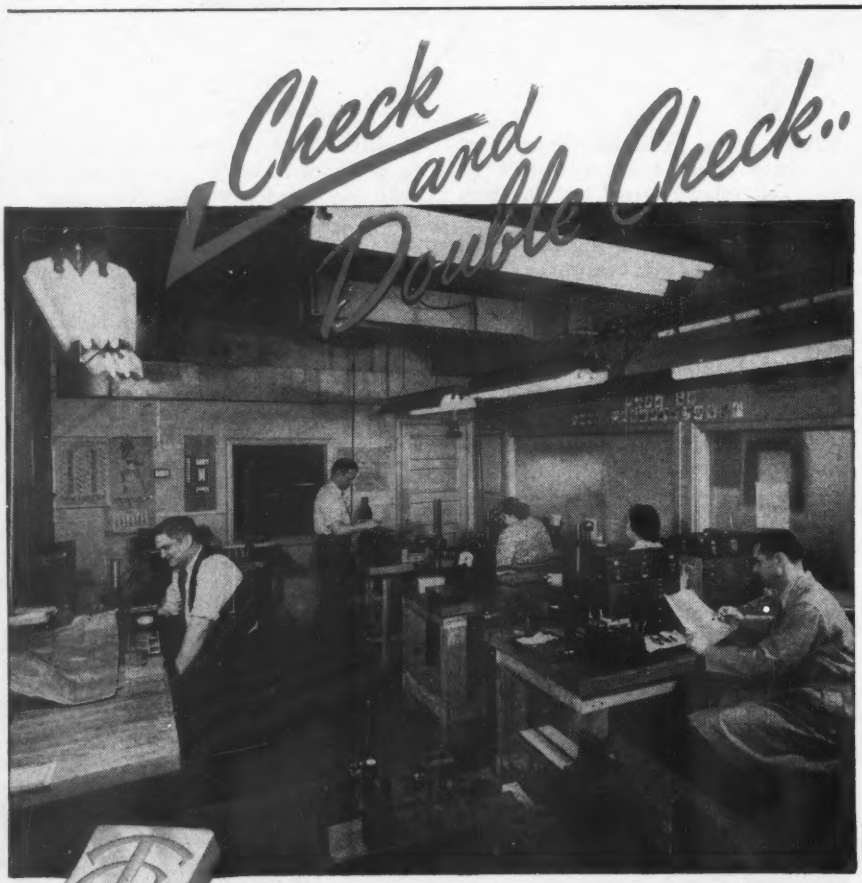
rectangular pattern, and while diagonal takeoffs and landings are possible traffic is always set either east or west in line with the longest dimensions of the field.

The notable success of these two-way operations, despite frequent cross-wind conditions, indicates conclusively that small cities planning conservative airports can provide adequate landing facilities with only one runway.

Handiness a Feature

Any discussion of Jennings Airport's unique success could not avoid noting that it is barely outside the city limits and is less than 2 mi. from the center of town. The fact that students and plane owners can reach the field in five to ten minutes has been instrumental in the fine growth of activity at the field.

What has happened at Jennings could happen at nearly any airport. The simple ingredient which has made the operation profitable has been the realization that running a flying service is no different from any other kind of business. Neatness of premises, genuine service to the public, and business-like management always pays off.



...before this stamp of Precision appears on TURNER Gauges

THE VERY last operation performed on any Turner Gauge before packaging is the application of the Turner Stamp, which you see reproduced above. Prior to this, every Turner Gauge has been checked and double checked in our air conditioned, temperature controlled inspection room. *It is your guarantee that all checking surfaces are accurate to your specifications.*

★ *We make cylindrical plug gauges, Plast-O-Lock plug gauges, cylindrical ring gauges, special flush pin gauges, solid type snap gauges, Master Discs, and built-up gauges.* ★

TURNER BROTHERS

TURNER GAUGE GRINDING COMPANY
2825 HILTON ROAD • • FERNDALE 20 MICHIGAN

Boeing Stratocruiser

(*Continued from page* 181)

lb. of goods and featuring a drive-up ramp in the rear and special internal cargo-handling equipment.

According to the company's calculations, the direct operating cost would be but 1c. per passenger-mile in the passenger version and 5c. per ton-mile in the cargo craft.

Ship maintenance, states Boeing, has been designed to be as simple as possible to keep indirect costs low, with the fuselage constructed so that equipment and mechanical operating devices can be serviced as conveniently as possible on the ground and likewise can be reached in flight for enroute checkups. All four power plants are interchangable and are stated to include improved maintenance features.

Boeing adds that it has also been conducting design work on several other type craft to meet postwar needs, including feeder-line planes and local-service aircraft.

The company's detailed specifications and performance data on the Model 377 are given below:

Specifications and Performance

Span	141 ft. 3 in.
Length	110 ft. 4 in.
Height	33 ft. 3 in.
Weight, empty	70,000 lb.
Weight, gross	130,000 lb.
Weight, landing	105,000 lb.
Engines	4 of 3,500 takeoff hp. each (2,800 rated)
Speed, max. and cruising	400 mph. and 340 mph.
Operatjng range	3,500 mi.
Operating ceiling	30,000 ft.
Propellers	4-blade, 16 ft. 7 in. dia.
Landing gear	Tricycle, dual wheels throughout
Wing section	Boeing "117" (same as B-29)
Tail surfaces	Same as B-29
Fuselage dimensions	Max. cross-section: Height 15 ft. 9½ in., width 11 ft.
Main passenger cabin, length	60 ft.
Passenger cap., day version	100 passengers
Passenger cap., sleeper	72 day passengers, 36 berths plus 14 lounge seats
Crew, transcontinent	3 operating, 2 in steward's dept.
Crew, transocean	4 operating, 3 in steward's dept.
Cargo cap., passenger version	750 cu. ft.
Cargo cap., all-cargo version	3,000 cu. ft. usable space, 35,000 lb

Repairing 'Round the World

(*Continued from page* 193)

At this point, the mechanicommandos were closer to the battle line than any other service organization in the 9th Air Force, which was then operating out of Cairo. Immediately following the breakthrough at the Mareth Line, a forward echelon moved to Kairouan, Tunisia, to operate from advance airfields only 15 to 20 mi. behind the front. At Castel Benito, servicing began for the famous "Earthquaker" medium bombardment group and the two American fighter groups supporting the British 8th.

The entire Castel Benito Airdrome,

one of the largest in North Africa, was under the complete control of the wandering ASC men; they operated the Air and Freight Service, which was growing to gigantic proportions. The Air Freight section handled 350,000 tons of freight a week. Base Operations was handling 53 passenger planes a day and 1,000 passengers a month. The finance section of the group was paying 43 different American units in forward and rear areas with a payroll amounting to more than $650,000 a month. Base workshops had been erected in the spacious Italian hangars and third and fourth echelon work was performed.

The advance element of the organization, then at Kairouan, was doing on-the-spot repair work at the bases, but whenever third echelon work was required, the planes were sent back to Tripoli and the base workshops.

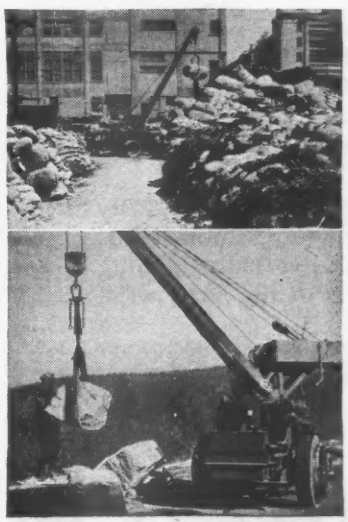
At this point American rations were available for the first time in six months and, naturally, a noticeable improvement in morale was noted. Movies, too, were secured and many USO shows were diverted from the American organizations in North Africa for a one-day stand at Tripoli. Jack Benny and his troupe appeared, as did the Bob Hope show.

As the tempo of the Allied attack increased, the soldier-mechanics began to work a 24-hr. day. The advance elements in Kairouan and later in Sfax, Tunisia, were also working full capacity. The fighter groups at those fields were flying seven and eight missions a day, necessitating frequent engine changes and general overhaul of planes and equipment.

The Tunisia heat started bothering the men the latter part of March, when temperatures ran well over 100 deg. for weeks at a time. Tools became too hot to handle; men received second-degree burns merely by touching the planes. Finally, it was decided to work early mornings and then evenings until dusk only. Subsequently, in the afternoons, swimming parties were organized, trucks taking the men to Sousse, Tunisia, 35 mi. away, on the coast. It was found that the men were able to work with greater efficiency in the cool of the evening, and greater benefits were derived by all concerned.

The Tunisian campaign came to a sudden close on May 10 and the entire group heaved a vast sigh of relief. From the moment they arrived in Africa, in Sept. 1942, to the close of the campaign they worked at top speed, repairing, servicing, feeding, clothing, paying, and providing communications for the many Air Forces organizations working with the British 8th. After short furloughs, advance elements moved back to Causway, Tunisia,

The fast-action all-around-your-plant load-handler



Roustabouts are engineered and built for years of overwork—rugged construction, ball-bearing boom turntable and operating parts run in oil.

BIG crates onto truck . . . heavy stuff off or on a freight car . . . overhauled engines remounted to aircraft . . . scrap metal loaded with a magnet . . . bales, drums, boxes picked off a high pile—or stacked there . . . machines moved . . . hundreds of different load-handling jobs—and your Roustabout is always ready, where and when you want it. It's most kinds of material handling all in one, mobile, versatile, powerful, saving time, cost, manpower. Hundreds of industries report their Roustabout Cranes invaluable, indispensible. Make one of these handy action-getters a part of your plans for postwar efficiency and expense cutting—write for the whole story, today.

THE HUGHES-KEENAN COMPANY
637 NEWMAN STREET • MANSFIELD, OHIO

ARMY E NAVY

ROUSTABOUT CRANE

Roustabout Cranes
By Hughes-Keenan
Load-Handling Specialists Since 1904

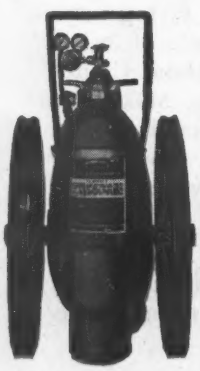
PLUS-FIFTY DUGAS DRY CHEMICAL WILL BE NEEDED HERE... P.D.Q.

Things like this should never happen. But they do—and that's why DUGAS Extinguishers with PLUS-FIFTY DUGAS Dry Chemical should always be within easy reach.

Flammable liquid fires... flammable gas fires...electrical equipment fires *all* yield quickly to the fast fire-killing action of PLUS-FIFTY DUGAS Dry Chemical.

Immediately on striking flames, PLUS-FIFTY DUGAS Dry Chemical releases fire-smothering gases that quickly extinguish dangerous fires. Small fires don't have a chance to get BIG.

PLUS-FIFTY DUGAS Dry Chemical is non-toxic, non-corrosive and non-abrasive. Hurts nothing except fire. For all the facts, write today!



MODEL 150 WHEELED EXTINGUISHER

Approved by Underwriters' Laboratories and Factory Mutual Laboratories.

SEND FOR FREE CHART showing characteristics of all types of approved hand fire extinguishers.

PLUS-FIFTY duGas REG. U. S. PAT. OFF. DRY CHEMICAL

AV-3-44

MODEL 30-T HAND EXTINGUISHER

ANSUL CHEMICAL COMPANY, MARINETTE, WISCONSIN
DUGAS DIVISION

where the fighter groups were engaged in sea sweeps off the coast of Italy and in escort work in support of the American and RAF bombardment groups pounding the beaches and cities of the Sicilian island.

Suddenly the advance elements of the outfit moved to the Island of Malta. The initial American organization to be stationed there, it raised the first American flag ever flown by a military unit on the historic island. The organization did not move into operation on Malta, but merely marked time with the fighter groups which arrived shortly afterwards. Everybody waited for the Sicilian offensive to start.

This campaign found the Service Group back at work again and happy, for enforced idleness had begun to get boring. The opening days of the campaign brought daily raids by the Luftwaffe. None of the personnel was injured and the men continued to service the P-40's of the two fighter groups they had become acquainted with back in Tripoli.

Living conditions in Sicily were crude. Because of the necessity of traveling light, the men had brought the barest of clothing and working equipment. There were no beds, tents, or permanent camp areas. Everyone slept on the ground beneath the wings of the planes being worked on. Food was always scarce—C rations were eaten three times a day.

A courier air service was maintained with the rear echelon headquarters in Castel Benito, and essential parts, replacement clothing, and other items were flown to Sicily whenever demanded by the advance party. The capture of Catania, Sicily, by the British 8th marked the turning point of the campaign, and ASC personnel were among the first Americans to enter the city.

In 38 days the campaign ended, as dramatically as it began. The rest period didn't last long, however, for the Italian invasion was then launched. Six days after D day, the Service Group was on the move again, into Italy, following in the wake of the British forces.

The swift British advance up the heel and toe of the Italian boot found these mechanicommandos struggling along in an endeavor to keep pace. During this first month of the campaign, the outfit didn't have time to get all its equipment unpacked. By the third month, the battle line was stabilized and the men were able to put up tents, unpack all their tools and equipment, and operate with their full resources.

At this time the globe trotters had men strung all along the western coast of Italy, repairing planes which the rapid advance had dictated be left

behind. The rear party, which had been operating out of Castel Benito, Tripoli, all this time, then pulled up stakes, and for the first time in over five months the entire Service Group got together again on the plains of Foggia.

The Italian Chamber of Commerce was caught red-handed here, for the much vaunted "sunny" Italy was a great disappointment to all the troops who sloughed through almost continuous mud and rain.

American rations became plentiful for the first time since the outfit arrived overseas in 1942. These rations, plus fresh fruits and vegetables secured by local purchase, made the daily menus a real treat. And for the first time since the start of the Sicilian campaign the men were given passes. A rest camp was established on the Adriatic coast where the men could forget the war and relax for a week. Outstanding food was served at this camp, and the men were free to come and go as they pleased. Sports were available for all.

At the start of 1944 the men plunged back to work again when startling news was announced: They were going to the China-Burma-India theater.

India, however, proved merely a stopping place on the way to China. The travelers did not go into operation there in any sense of the word. They were given opportunities to visit Bombay and Calcutta and generally rest up a bit after the long, tiresome journey from Italy.

Then came the journey to the Assam Valley and the flight over the Hump to China, where conditions were as pleasing as they were surprising.

For the first time in 23 months they were able to sleep in barracks, on clean sheets. Showers with hot and cold water were at their disposal whenever they wanted them. The mess was far different from what they had been accustomed to. Instead of mess kits the men are now eating from spotless dishes. Instead of weary monotony of emergency rations, they now eat tasteful Chinese food interspersed with plenty of beef and steaks.

This unusual condition prevailed because the forces of Air Service Command had been commissioned some time ago by Gen. Chennault to do all the housekeeping and ground duties required. Result: sector command men became the cooks, bakers, butchers, landlords, telephone men, policemen, carpenters, engineers, and what-all, for the air operational units in China.

Greeting Col. Cunyus on his arrival in Cathay was Gen. Joseph W. Stilwell. The colonel told the general that there was just one place left for his outfit to go and that was home—but only via Japan. They'll make it, too!

THIS "QUICK CHANGE" CHUCK

HAS 100 USES

Pays for itself in 30 days in saving on drill costs alone

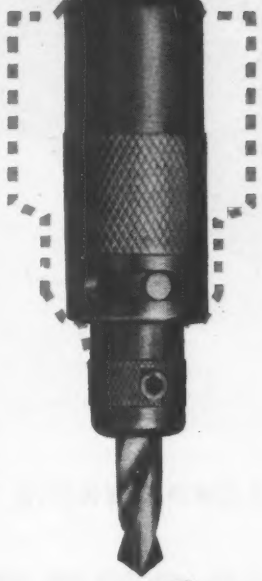
Uses broken twist drill flute ends

Cuts drill costs ½ or more

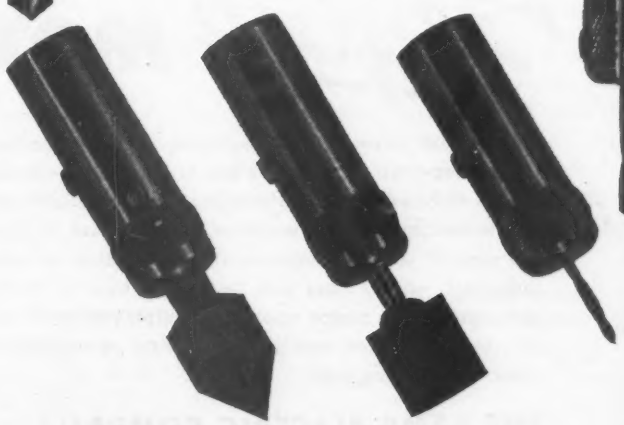
Saves time

Self-locking

No chuck key



This Zephyr "Quick Change" Chuck saves money and time wherever drill presses or portable drills are used. Only 3 parts: the chuck body, a spring inside the body and the quick change adaptor. No key to use or lose . . . simple self-locking bayonet lock holds adaptor securely in the chuck body. Uses broken drills, new drills, grinding quills, countersinks, reamers, deburrers. No repairs needed . . . nothing to wear out . . . less weight . . . small diameter . . . lower cost. *Order a trial quantity.*



Standard spindle thread ⅜-24; Adaptor maximum hole .257; minimum hole #50

WRITE FOR LATEST CATALOG

ZEPHYR

HIGH QUALITY PRECISION TOOLS

ZEPHYR MANUFACTURING COMPANY

Factory and Head Office

201 Hindry Avenue, Inglewood, California

Dealers located in all principal cities.

LOW WEIGHT . . . COMPACTNESS IN

Flying MOTORS!

Thirty years' experience in building fractional horsepower motors for all types of special applications has taught us where and how much weight can be reduced without interfering with essential electrical characteristics. • Low weight and compactness, so important in *flying motors,* increase the ease of use and improve the appearance of portable equipment for industrial, office, store and household use. • If you are developing or redesigning any motor operated equipment, write for a copy of our new 42-page illustrated catalog containing specifications, dimensions, and other engineering data.

THE LAMB ELECTRIC COMPANY • KENT, OHIO

Lamb Electric

FORMERLY *Black & Decker Electric*

SPECIAL APPLICATION FRACTIONAL HORSEPOWER **MOTORS**

THOROUGH ENGINEERING is the basic factor behind the successful operation of this de-icer pump motor and many other special application motors we have designed for all types of equipment.

Your Local Market

(*Continued from page* 124)

civilian population in your territory—figures which can be obtained from local newspapers or Chambers of Commerce—apply the present OPA national average figure of 33.6 percent or the previously-noted 10 percent to determine the number with incomes above $2,500 per year. Of this group take 1 percent, the amount estimated to be the first prospects for a personally owned plane.

Adding the number of service airmen, registered owners and pilots, and the civilians gives an estimate, based on national averages, of how many prospects you have on which to build your plans.

Each individual dealer, though, must estimate how many of those prospects he can sell and how many his competition can sell.

As a starting point to determine where these prospects are located, the local Chamber of Commerce can tell, by street boundaries, where the high and upper-middle rental areas are. Concentrate on the $60 per month and up areas. If the chamber doesn't have this information, the local newspaper no doubt will. Thus, armed with a street map and a city directory or an automobile registration directory, you will be able to learn where the group lives from which it has been estimated that 62 percent of the personal plane sales will originate.

Through a good, live, consistently followed-up mail, phone, and personal call solicitation—proven and efficient means of finding prospects—it is possible to sell this 1 percent economically. It is in this phase of aircraft distribution that many automobile distributors and dealers will be successful, where there will be failure on the part of those who have made flying and not merchandising their chief activity.

This is a subject on which volumes could be written, but in any event sound advice can be had from successful merchandisers in other well-established lines of high-unit-value items.

Meantime, we present (on page 123) a tried and proven sales solicitation program which, if followed diligently, will produce good results.

This solicitation program uses direct mail advertising. Well-prepared mailing pieces can be of the greatest help in softening up your prospects, in getting your message over to those in a select group, and in preparing them for your personal contact, if not actually selling your product. Although many business men consider direct mail an inexpensive means of advertising, they too often believe it ineffective. All too typical is this remark: "Here it's February and a tough

FOR FINER
FASTER FINISHING
Use DREMEL MOTO-TOOLS
Model 2 Moto-Tool, complete with accessories, as illustrated, in felt-lined hardwood case—$23.50. Model 2 Moto-Tool only, with emery wheel point — $16.50.
27,000
R.P.M.

Used in machine shops and tool rooms for finishing intricate dies. Used on production lines to clean castings, turnings and forgings . . . sharpen tools and do hundreds of grinding, finishing, polishing, burring, routing and etching operations.

Dremel Moto-Tool has AC-DC motor with shock-proof bakelite housing, oil-sealed (oil-less) bearings, and built in cooling fan. Weighs only 13 ounces—so light and compact a *girl* can handle it with ease. Dynamically balanced armature eliminates vibration and provides precision control. Moto-Tool's high speed (27,000 rpm) permits finer, faster work—conserves cutters.

Dremel Moto-Tools are proving indispensable aids in speeding up war production in such plants as General Electric, Westinghouse, Remington Arms, Ford, Nash-Kelvinator, Consolidated Aircraft, Douglas and Northrup Aircraft, and many similar "Arsenals of Democracy."

Try a Dremel Moto-Tool on your own jobs—in your own shop. See how versatile, how indispensable it is—how it saves time and materials. Order from your distributor or contact a Dremel Representative. PROMPT SHIPMENT on orders with proper priority.

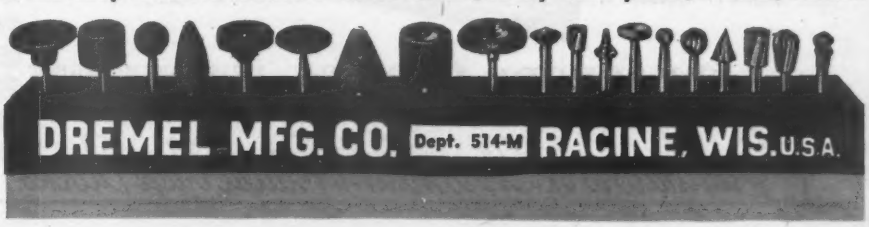
Federated Sales
2437 W. Valley, Alhambra, Calif.

Mill Factor Products
53 W. Broadway, New York, N. Y.

F. W. Fowler
137 Federal, Boston 10, Mass.

J. J. Backer
2321 Second Ave., Seattle, Wash.

Whether you have a Moto-Tool or any other type of grinder, use only genuine Dremel shop-tested Accessories—steel cutters, emery wheel points, brushes, sanders



DREMEL MFG. CO. Dept. 514-M RACINE, WIS. U.S.A.

month for sales, so we'll keep expenses down and use direct mail, since we must have some mailing lists around here we can use." And all too often an old list is found and a mailing sent out that is not very carefully prepared. Then when no results are obtained, the sales manager complains that "we mailed 450 of those lousy things and didn't get one single answer." This is really not a condemnation of direct mail, but rather of this particular sales manager's conception of direct mail.

In handling newspaper ads, radio announcements, magazine ads, posters, and other media, the greatest care is generally shown and usually professional advice obtained, but for direct mail the job is too frequently merely given to some employee, very often accompanied with no more thought than: "Charlie, get up a letter to mail out this month and stir up some business." Charlie may be a clerk, a bookkeeper, or a salesman, but not necessarily an authority on advertising. To eliminate these evils, this procedure is suggested:

First select your list of prospects, making certain they can reasonably be considered prospects and that they live in a radius that could practically be considered your "customer area." Next, give careful thought to the type or types of mailings to be sent.

Mailings should not be made to hot prospects. These people should, of course, have immediate personal calls. Others perhaps should be called "suspects" and mailings should be tailored to fit the various types. To the old account, try an offer of a free service—say, free installation of some accessory on which you have a high gross profit, or a gift of a merchandising item such as a chart holder, in short something to entice him to again become an active customer. Likewise letters to other types of prospects should be carefully drafted, personalized, and well-groomed before being sent out. To executives of local companies, for instance, try a letter which invites them to take a free flying lesson, setting up a choice of two dates but asking them to call if neither of the dates is convenient, so they can set their own time.

There are many ways of suggesting action, and if there is no one in your organization who knows from experience how to frame such personalized, action-getting letters, seek competent professional advice and help. In many cases this may be available from the manufacturers of the line of planes you decide to sell.

One kind of prospect would be sent several mailings progessively for what is called building a customer—selling your product. This entails more money being spent on postage and mailings. Another kind of prospect would be the more carefully chosen man or woman who should be sent one or two mailings, in each case with a personal-call follow-up. Remember, though, to limit the mailings to the number of customers you and your salesmen can contact.

It should also be borne in mind that this program is built around classifying prospects, telling where to find their names and addresses, what and when to mail, how to keep your records, who to call on and when.

It should not, however, be considered your entire advertising program. Rather it should be a complement to all the other advertising done, such as that in newspapers, signs, window displays, etc. It is a plan which, while effective in itself, will help make all your other efforts more productive.

Now consider the third major question: "How much of an organization is needed to do a well rounded, profitable job?"

First make up a budget. This is a vitally important cog in the merchandiser's wheel of success. An estimate of your sales volume reduced to your

Now... REASONABLE DELIVERIES ON ALL ELLSTROM GAGE BLOCK SETS

You can now order your set of the famous Ellstrom CHROMIUM PLATED Gage Blocks and we can promise you reasonable delivery. Our stepped up delivery schedule applies to either "Working", "Inspection" or "Laboratory" sets. Just drop us a note asking for precise information.

Yes, all Ellstrom-made Gages are CHROMIUM PLATED to give them very superior wearing qualities. These gage blocks by actual test wear many times longer. It's the finest gage block that money can buy . . . and solidly backed by a family tradition of fine precision gage making.

Ellstrom Chromium Plated Gage Blocks offered individually or in complete sets in three classes: WORKING Sets with guaranteed tolerance of ±.000008" INSPECTION Sets with guaranteed tolerance ±.000004" LABORATORY Sets with guaranteed tolerance of ±.000002".

DEARBORN GAGE CO. 22035 BEECH STREET DEARBORN, MICHIGAN

Originators of Chromium Plated Gage Blocks

gross profit less your expenses will in *any* business be the amount of money you will make. The accompanying illustration gives an outline for a suggested budget, with each major overhead item listed. These must be adjusted to fit the problems of your location and market, using the percentage of gross profit on the lines of planes you expect to have for sale.

Starting with the business you estimate you will be able to do after analyzing the potential, as previously suggested, fill in the statement. You may have to change your first estimates and expenses when you get down to that final item, "net operating profit"!

The fourth and last major problem with which to wrestle is: "How much of a showroom; and should it be downtown or at the airport?"

From a theorist's point of view, downtown is the logical and only answer. But this is the sort of problem we can help solve by a careful look at the answers to other questions. We have a fair estimate of the number of planes that will be sold in the territory and a reasonable approximation of how many of those sales can be taken from competitors.

If that figure, when applied to the budget, will permit an amount under rent for a good, downtown location, it would seem advisable to include this in immediate postwar plans. If, on the other hand, the budget does not say yes, then don't do it now, but keep alert to increases in sales which will make possible such a move. Whether downtown or at the airport, make adequate provision for a good well-lighted well-decorated showroom. It will prove to be your best sales clincher.

Fix-It School on Wheels

(*Continued from page* 154)

tract by the aircraft companies and some by AAF personnel. Actual working parts of the latest models of aircraft are cut away and mounted for instructional display. Virtually all of the mockups are operative, enabling pilots and service mechanics to see at a glance just what takes place in a system or piece of equipment while an airplane is in flight. Batteries or generators are used to supply the motive power.

Much ingenuity and care has been shown in the creation of the mockups, and further, they are constantly being changed by the MTU instructors as new equipment and techniques are developed. For example, if the manufacturer adds a new carburetor to the engines for a B-17, the flight engineer and ground crew must learn its operating principles and how to re-

fluid power flows

THROUGH THIS VITAL LINK

Engineered by PARKER

THE PARKER COUPLING

Is the key to the vital link, engineered and designed by Parker—protected against leakage and vibration, precision-made, quick to install, quick to service.

A. A. F. SURPLUS WAR STOCKS

Parker has been selected by Metals Reserve Company to market surplus A. A. F. war stocks of valves and fittings. Immediate delivery assured. For specifications and installation recommendations, write, wire or phone.

PARKER SERVICE AGENCY
Division of
THE PARKER APPLIANCE CO.
Cleveland 12, Ohio, U. S. A.
Agent for
METALS RESERVE COMPANY

Fluid Power, the modern way to get things done, is carried wherever you want it to go through tubes, and controlled by valves.

You think of Fluid Power as a three-link chain; Source—Circuit—Utilization.

The *key link* is the Circuit—straight line, around corners, into tight places, under direct or remote control. That *key link* is vital, for the successful operation of any Fluid Power application depends on it!

It's Parker's business to engineer this vital link—to design it, build it, install it—to build the precision valves and fittings that make it function, and the tools to handle them. We've been at it for twenty years.

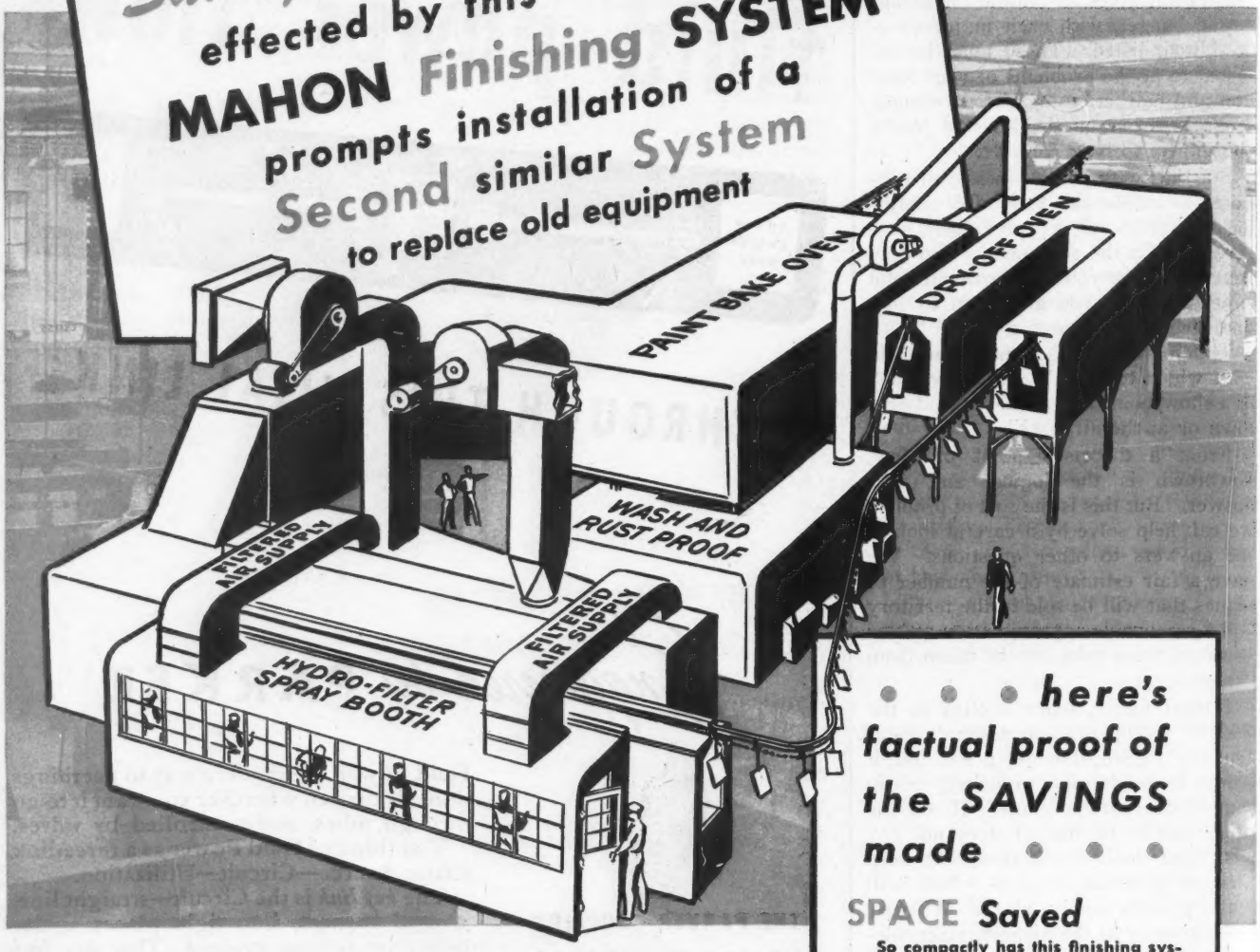
Fluid Power Engineering is a young science, based on the old familiar principles of hydraulics. War has intensified its uses—multiplied the number of jobs it can do.

Whatever kind of equipment you operate or build, or plan to build, chances are Fluid Power will make it work better, or cut its cost, or increase its usefulness.

A Parker Fluid Power engineer will gladly discuss these interesting ideas with you. Write to The Parker Appliance Company, 17325 Euclid Avenue, Cleveland 12, Ohio.

THE PARKER APPLIANCE COMPANY
CLEVELAND • LOS ANGELES
FLUID POWER ENGINEERING

Savings—
effected by this
MAHON Finishing SYSTEM
prompts installation of a
Second similar System
to replace old equipment



A finer, better product—*faster*

Back in 1940, one of the larger Eastern manufacturers installed a MAHON Finishing SYSTEM to augment finishing equipment already set up. Then came the speed-up of war production—presenting an unusual opportunity to compare the operational cost and productivity of the old and new systems, handling approximately the same work. So great have been the savings effected by the Mahon System over the old equipment, the management has decided to replace this old equipment with a second new and modern finishing system, designed, built and installed by Mahon. Work is now in progress and the new system soon will be in operation—assuring still further reduction in finishing costs, both on present and on future peacetime products.

Mahon engineers will be glad to give you the story in detail—and accord you fullest cooperation in working out a solution to YOUR finishing problems.

• • • *here's factual proof of the SAVINGS made* • • •

SPACE *Saved*

So compactly has this finishing system been engineered, it occupies considerably less area than the old equipment—conserving greatly on floor space.

TIME *Saved*

Continuous conveyor production, throughout, disposes of needless repeated handling and the possibility of damage to product. Important reduction in cost and time results.

MANPOWER *Saved*

With the exception of spray painting operations, the system is almost entirely automatic. Men, formerly required, now are released for other essential work.

THE R. C. MAHON COMPANY

DETROIT 11 — CHICAGO 4

Manufacturers of Metal Cleaning Machines • Rust Proofing Machines • Hydro-Filter Spray Booths • Ovens of All Types • Filtered Air Supply Units • Hydro-Foam Dust Collectors—and Many Other Units of Special Production Equipment—including Complete Finishing Systems

pair it; therefore, a mockup is made of the carburetor installation, and it is incorporated in the equipment of the B-17 mobile training units.

The mockups are ideal training devices. In the hydraulic display, pilots and ground crew can see the action that steers the nose wheel and learn why careful snubber servicing is important to prevent shimmying or failure when landing or taking off. They learn correct maintenance to insure perfect operation of landing gear and cowl flaps, how brake efficiency depends upon proper clearances and perfect operation of de-boosters, also why sufficient air pressure must be maintained in the hydraulic accumulator and what happens if a leak develops and how to take care of it.

In the propeller mockup is a full size prop with blades clipped, and a cutaway view of the hub and governor. Oil supply is shown in transparent plastic tanks and pipelines. The instructor demonstrates how the hydraulic system functions to control propeller pitch during normal flight, likewise he instructs pilots regarding the equipment that feathers the propeller.

Engine specialists among the ground crews can study another mockup which shows the actual flow of fuel from transparent tanks through transparent pipes to the strainer, booster pump, firewall shut-off valve, engine driven pump, and finally into the carburetor.

On the electrical display panel are the switches and operating gages of the plane; also, the landing gear warning system, emergency alarm bell warning for bailing out, and electrical fire warnings of flames in an engine or compartment.

Another mockup shows fire extinguishers in engines and compartments, wing and stabilizer units, and nose heaters. All displays have a threefold purpose; To teach equipment operating principles, to explain maintenance, and to emphasize repair short-cuts.

One of the primary functions of the units is to combat accidents due to mechanical malfunctions. By teaching old crews the latest technical tricks, many accidents have been prevented, and many planes and their crews saved for action against the enemy.

An outstanding feature of all mobile training units is the flexibility of their instruction program. MTU's go beyond—and in a sense, excel—the formal type of classroom instruction, since, save for preliminary lectures on new equipment, all work done by the students and instructors is practical. Theory is held to a minimum. Little time is lost on phases that are well understood, and emphasis is placed on solving particular problems, and on

LOOK TO CANNON 'DP' CONNECTORS IN 1945

HERE ARE A FEW OF THE 'DP' CONNECTORS AVAILABLE *NOW*— AND MANY NEW DESIGNS ARE COMING

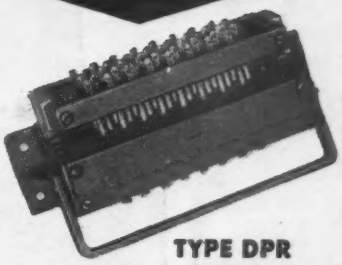
NEW applications of the exclusive Cannon Electric "DP" series of connectors have recently been extended from rack equipment in radio assembly to such uses as special centralized aircraft control on through to signal relay equipment.

Several new "DP" connectors of strikingly new design will be released in 1945—testimony to the progressive engineering Cannon Electric incorporates into its products. Since Cannon Electric pioneered the aircraft electrical connector in 1932, this development process has gone steadily onward. Cannon is prepared to meet the demands of postwar electrical equipment.

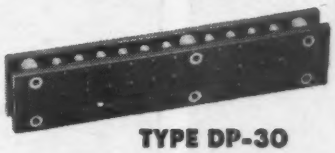
Cannon Type DP Connectors cover a variety of rack, panel and bail-type fittings, carrying from eight to 135 circuits with amperage range from 10, 15, 30 and 40 in many varied arrangements, including coaxial contacts.

All these and many other high quality electrical connectors are Cannon designed and manufactured.

For detailed engineering data on Type DP Connectors refer to the Cannon DP Bulletin. Write to Department A-110, Cannon Electric Development Company, 3209 Humboldt Street, Los Angeles 31, California.



TYPE DPR



TYPE DP-30

TYPE DP-D

TYPE DP-P10

CANNON ELECTRIC

Cannon Electric Development Co., Los Angeles 31, Calif.

Canadian Factory and Engineering Office:
Cannon Electric Company, Limited, Toronto

CANNON ELECTRIC

REPRESENTATIVES IN PRINCIPAL CITIES—CONSULT YOUR LOCAL TELEPHONE BOOK

YOU CAN'T STRIP THREADS WITH THE

Won't Over-tighten • Saves Screws, Nuts and Bolts • Standardizes Assembly

215 West 7th Street, Los Angeles 14, California
Eastern Representative: 428 New Center Building, Detroit, Michigan

refresher instruction, short-cuts, and trouble shooting.

The units generally spend about two weeks at each base. Classes are set up in empty hangars, barns, on the line, or at any convenient place designated. Schedules are planned so as not to interfere with combat missions. The schedules are always directed at the problems of the particular base. Much of the value of the MTU's lies in the information picked up in their travels; if the mechanics at one base have developed a short-cut solution for some malfunction, this knowledge is passed on by the MTU at the next base. As a result of the variety of experience gathered by the instructors, many procedures for both operating and servicing techniques have been developed by the unit instructors themselves.

The complement of each MTU varies from 6 to 15 men, according to the type of equipment carried. Each unit has an officer in charge who maintains the instructional program, handles arrangements for housing and messing and other necessities of the men, and takes care of reports and liaison with the base training officer. Some of the crews include a civilian factory representative who provides additional help in solving aircraft problems and instructing in latest modifications and short-cuts.

There is a story behind the development of these mobile training units. During the vast expansion of our air forces after Pearl Harbor, our AAF trained hundreds of thousands of skilled pilots, bombardiers, avigators, gunners, flight engineers, airplane mechanics, radio operators, and other specialists needed to fly our warplanes and to keep them flying. This job was accomplished at hundreds of flying fields and AAF technical schools throughout the United States.

Shipped overseas with combat squadrons and groups, these men were thoroughly capable of flying and servicing the planes in use at the time of their graduation, but the constant and rapid rate of modifications and changes and improvements in our combat ships presented the problem: How can they be kept in step with technical advances?

This problem had become acute in 1942 when new craft were presenting operational and maintenance difficulties at the bases where they were being flown. The mobile training unit was the answer to this problem.

It was at a conference in Los Angeles that MTU was conceived. In attendance were Maj. Gen. Walter R. Weaver, retired, formerly commanding general of the old AAF Technical Training Command, and Maj. Gen. John F. Curry, former commanding

general of the western division of the command, together with representatives of the Allison Engine Co. and the Lockheed Aircraft Co.

A set-up was initiated which included the use of Fruehauf trailer trucks as a standard unit. The mockups and cutaways of all the important functional parts of the plane were constructed, then other instructional equipment, including schematic drawings, projectors for training films, charts, diagrams, and complete files of technical orders and factory operational directives, were added. "Faculties" were assembled, consisting of handpicked enlisted specialist instructors, seasoned graduates of factory and technical schools of the air forces, with an officer in charge.

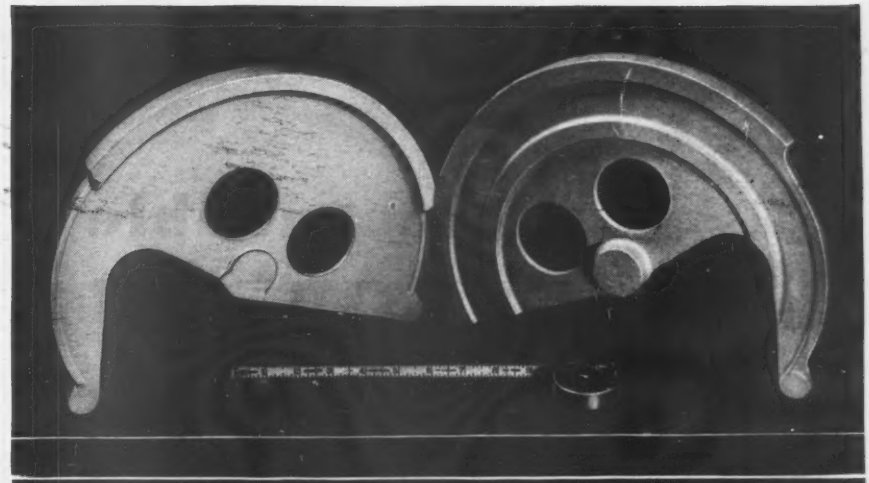
The first mobile training unit, with mockups of Lockheed P-38 Lightning equipment, began its travels on July 2, 1942. Operating at air bases where P-38 groups were being processed for overseas, it became immediately apparent that the solution to a critical training problem in the AAF had been found. Other units were constructed and equipped for the latest models of fighter, bomber, and cargo planes. Requests poured in from bases all over the country for MTU's. Expansion was rapid as they proved successful.

Steps were then taken to design units capable of having the instructional equipment packed into cargo planes to be flown where needed with its staff of teachers. The first such units were sent to Air Transport Command bases in the then combat-active Aleutians. Later, other units were flown to Laborador, Newfoundland, Iceland, Africa, and Caribbean bases. Still later, when transportation facilities and time permitted, the instructional equipment was packed into the 5-ton trailers and shipped overseas to combat theaters, where they could move from base to base. Today, these mobile training units are in use in every combat zone where American Air Forces are operating.

Mobile training units are organized, constructed, and operated by the Army Air Forces Training Command's western technical training division headquarters at Denver, Colo. The units remain under the control of the Denver headquarters, whether operating within or without the continental limits of the United States. They are placed on temporary duty with the domestic and overseas air forces for a period not in excess of six months.

After six months duty with tactical air forces, the units are brought back to the United States for complete overhauling. Refresher courses for the instructors are given at factories.

After operating in one combat area



No costly metal failures here...

with parts of AMPCO METAL

The Emerson-Electric power-operated nose turret for the B-24 Liberator Bomber — designed to protect a formerly vulnerable spot — calls for the utmost in performance. Typical of engineering practice throughout the aircraft field is Emerson's use of Ampco Metal for critical parts. Significant also is Ampco's ability to provide, from one completely-equipped source, two centrifugal castings, two sand castings, and extruded rods from which small parts are machined. • Where safety and reliability depend upon exceptional resistance to wear, impact, and fatigue, you can depend on Ampco Metal. The Ampco organization offers you a complete service in engineering, production, and finishing of copper-base alloy parts, under strict quality control. Consult us, without obligation.

AA-5

Write for bulletins!

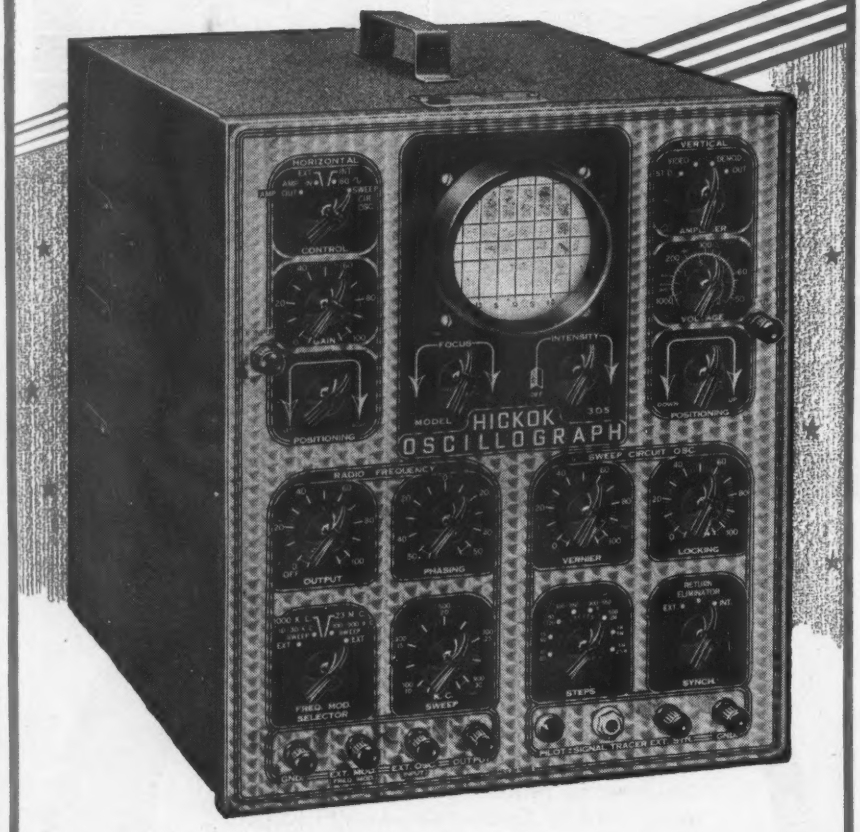
AMPCO Metal
The Metal without an Equal

Ampco Metal, Inc.
Dept. A-12
Milwaukee 4, Wis.

In Your Behalf

A dependable OSCILLOGRAPH

R. F. O.—5



The HICKOK OSCILLOGRAPH R.F.O.-5 is especially designed for frequency modulated, amplitude modulated, and television service. This is your instrument for COMPLETE VISUAL ANALYSIS.

Self-contained Wide Band and Narrow Band F. M. Oscillator, Demodulator, Video Amplifier, Signal Tracer, Visual A.C. Vacuum Tube Voltmeter. It features high sensitivity amplifiers, returns trace eliminator, calibrated screen, variable width frequency modulated oscillator, pilot light and phasing control.

Power supply, 110 to 120 volts, 50-60 cycles. Size, 11"x13"x15¼". Finished in baked crackle lacquer. Shipping weight, 55 lbs. Shipped on WPB authorization 3243. Otherwise, orders must be accepted for shipment after WPB restrictions are removed. Advise whether you wish New METER Catalog or New RADIO SERVICE EQUIPMENT Catalog.

THE HICKOK ELECTRICAL INSTRUMENT COMPANY

10525 DUPONT AVENUE CLEVELAND 8, OHIO

THE STANDARD OF QUALITY FOR A THIRD OF A CENTURY

HICKOK

the units are often sent to entirely different areas after the instructor personnel has been brought up to date and mockups and other teaching equipment is redesigned to represent the last word in modifications and change. The interchange of ideas between combat theaters, as accomplished by MTU's, has proved invaluable in spreading knowledge of maintenance and flight procedures.

Standardized Maintenance

(*Continued from page* 137)

planes of the Stearman primary trainer type per month, plus 150 engines. Minor repairs can, of course, be handled in from a few minutes to overnight, and not more than 20 days need be expended for a complete airframe overhaul or more than 12 days on engines. For smaller personal planes this time can be materially reduced.

There is no reason why the personal pilot, arriving at a field in the evening, can't have his plane inspected, serviced, and minor repairs or adjustments made in time for departure the next morning.

Can fixed base operators survive trying to offer such service? Many are so sure they can that they are spending plenty of hand-earned money to support that belief. Our company, for one, has just purchased Grand Central Airport, one of Southern California's prominent fields and former terminal for several major airlines. Improvements include a $70,000 engine test stand now being completed, together with other facilities which can be adapted from military to peacetime operations without material changeover.

The shops definitely will remain the same size and will offer the same capacity for peacetime operations as they have during the war. Naturally there may have to be some skeletonizing of personnel during the re-conversion periods, but it should be remembered that private and non-airline commercial flying has been prohibited on the West Coast during the war. The build-up should be rapid, however, as witness the fact that since Grand Central was opened to limited private and commercial flying on a point-to-point basis, three charter companies have established themselves there, and a number of personal planes have come in.

When flying again is freed from wartime restrictions another upsurge is certain. We can sign more than a hundred students for flight training within the first 24 hr. of receiving the green light. The certainty of flight training in secondary schools and jun-

BOWER
ROLLER BEARING CO.
Detroit, Michigan
Bearing GOOD WILL
BOWER
ROLLER BEARING CO.
Detroit, Michigan

. . . Straight to the point

Olofsson craftsmanship is able to help solve production problems requiring precision manufacturing. The organization is comprised of designers and builders of tools, dies, jigs, gages, fixtures and special machines.

Olofsson

TOOL AND DIE COMPANY
LANSING, MICHIGAN

CHICAGO ENGINEERING OFFICE — 600 SOUTH MICHIGAN AVENUE

ior colleges will also make certain another boost in business in short order.

This increased business is anticipated with utmost confidence because we will offer fixed base operations comparable to the sales and service offered in the automotive field. We will demonstrate and sell the airplane much as the automobile has been demonstrated and sold so successfully. We will have adequate storage space, as do garages. We will sell fuel and oil and provide adequate repair and maintenance service.

Where the garage has a street at its service door, we will have a runway; where the alert automobile service man offers maps and road information, we will have weather data and flight plan assistance.

We are ready for a new era of fixed base operations.

Supercharged Harness

(*Continued from page* 131)

not usually present, there had always been considerable flash-over trouble, but with the higher pressure of the supercharged harness this has been reduced to the equivalent amount experienced at lower altitudes with standard harness.

C & S pilots report they can now operate engines smoothly under any atmospheric conditions, and other airlines using the new harness report similar success. All airlines which have used C & S supercharged ignition have adopted it as standard at the termination of their tests. It is now standard on Northwest, Delta, National, Eastern, and United, and it is being tested by Pan American, also the Navy on its cargo run from Seattle to Alaska.

During the past 18 mo., Boeing Aircraft has been conducting a very complete series of experiments with B-17 bombers at high altitudes, and after using many types of harness and ignition this company's reports supercharged ignition harnesses is quite favorable.

Net result is that C & S has found itself literally forced into the manufacturing business. Not only have its own shop facilities been fully employed, but it has found it necessary to subcontract many items, which are later assembled at their C & S plant.

With high altitude flight assuming greater and greater importance in long distance air transportation, the necessity for trouble free ignition equipment becomes a ruling factor in design. The proven efficiency of the C & S method of ignition supercharging will undoubtedly contribute much to the operational success of high altitude aircraft.

PRESSURIZED CABINS OF THE B-29 MADE SAFE . . .

with REX-FLEX S.S. TUBING

First bomber to have pressurized cabins, the famous B-29 Superfortress uses Rex-Flex stainless steel tubing in providing supercharged safety for its crew at extreme altitudes.

Boeing engineers began planning years ago to make the B-29 the finest bomber in the world. Every square inch of the huge Superfort's design was carefully scrutinized—each component part, however small, was selected with exacting care.

Boeing engineers knew that the success of the B-29's pressurized cabin would depend upon its ducting system. That system had to be *right*. It had to be safe—non-collapsible, highly resistant to crushing, in order to stand the unbalanced pressures above 30,000 feet. That is why Rex-Flex stainless steel tubing—a product as truly modern as the B-29 itself—was chosen for the job.

Rex-Flex not only has unusual durability but is manually bendable in multiple planes to facilitate installation—can be assembled right on the job by any worker—and when once installed is the safest tubing for long, leakproof, fireproof performance. Here is a summary of the reasons why Rex-Flex is the flexible tubing for *your* job:

- Non-collapsible
- High crush strength
- Low line loss
- Air tight
- High vibration quality
- Fireproof
- Bendable in multiple planes
- Light weight

Rex-Flex was especially designed to meet aviation's need for a stronger, safer flexible metal tubing—now and in the future. Let us show *you* how Rex-Flex can help in combating corrosion or vibration in your present or postwar products. Write us today for the complete story.

Flexible Metal Hose for Every Industrial Use

ARMY E NAVY

CHICAGO METAL HOSE CORPORATION

MAYWOOD, ILLINOIS

Plants: Maywood and Elgin, Ill.

More Seats Up . . .

(*Continued from page* 135)

at the scales, while passing the work either from sewing machine or from stock to finish bench.

It will be seen that the total time lost in movement of the work has been reduced to about as small an amount as would seem practicable in a plant where the quantities are so small—frequently comprising single pieces and seldom exceeding enough for one airliner.

This shop layout is of particular interest in that it demonstrates how, with no increase in personnel or working time, and with the same equipment as formerly, a greatly increased output may be obtained, merely by planning the routing with a view to eliminating lost motion and interference through crossing paths during the production process.

Service Prospectus

(*Continued from page* 134)

these men will be divided into three categories in the domestic and foreign sphere: 1. Assistance to airlines; 2. assistance to the military forces; and 3. assistance to authorized stations and hence to the private owner.

Operational assistance to new airlines in establishing their shops, designing maintenance operations, and in determining maintenance schedules will be a typical service offered by the field engineering operation.

In addition, company field service men will be assigned to each district sales office and will work throughout the territory encompassed by the district. It will be the responsibility of these men to investigate troubles, assist authorized repair stations, and to work with the various airline maintenance organizations.

Service Training

The problem of training personnel for the maintenance of new aircraft is increasing in importance to the degree that it is now an essential phase of any service program. This is particularly true in regard to training on the larger transports now being produced or developed.

One objective of the company's training organization will be to develop courses of instruction, visual aids, and data through instruction of company personnel, and then to make available to the customer the same instruction for customer personnel. This may be accomplished by having the customer's personnel take training at the factory, or by having instructors from the customer's personnel take the training and later establish courses at their own operating bases. In any case, the Lockheed training school will assist in specialized or generalized courses of instruction to give most efficient utilization of new aircraft immediately after the purchase.

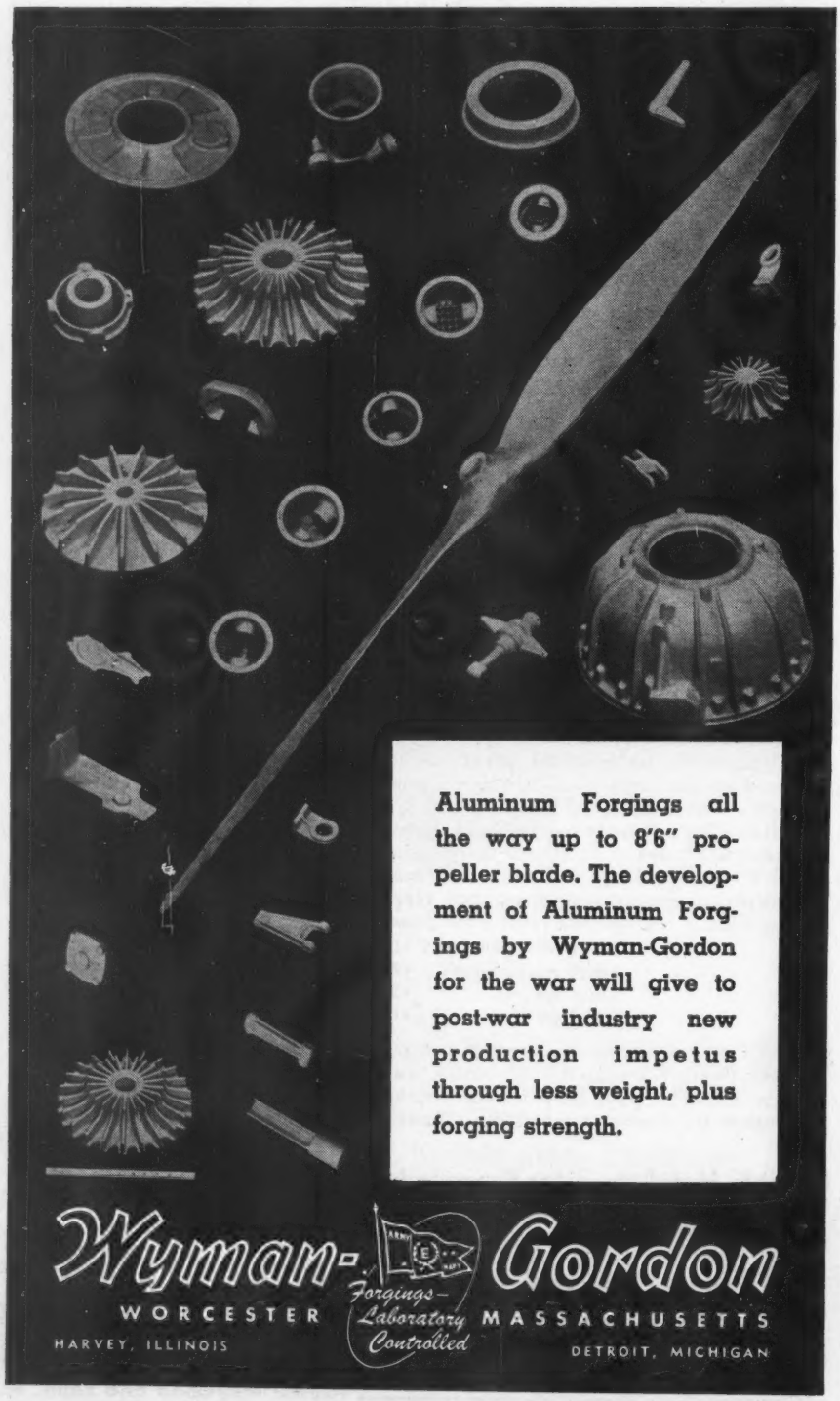
A second function of the school will be to train representatives from authorized repair stations in methods and procedures used in service and repair of the company's aircraft. Military training will continue to be given to whatever degree is determined by military requirements.

Administration

The administrative phase of the service organization will include the contracts, finance and accounting, material, scheduling, and all, of the varied functions entering into a normal administrative activity.

It is worthy of note, however, that the finance, accounting, material, and shop order systems in the service shops are being developed to permit their installation by any authorized repair agency not now employing a satisfactory system.

Time studies, estimating data, and time of performance information ac-


Aluminum Forgings all the way up to 8'6" propeller blade. The development of Aluminum Forgings by Wyman-Gordon for the war will give to post-war industry new production impetus through less weight, plus forging strength.
Wyman-Gordon
WORCESTER
MASSACHUSETTS
HARVEY, ILLINOIS
DETROIT, MICHIGAN
Forgings—Laboratory Controlled

cumulated over a period of several years' operation will be charted for the use of repair agencies working on Lockheed airplanes in order that a standard basis of time for accomplishment of work may be available to the customers.

The sketch-book planning outlined herein may be used in part, in whole, or in a completely revised form. The *functions* outlined will probably require manifestation in some form or another, and are therefore a good basis for individual consideration.

It would be unwise indeed, in these days of changing policies, new designs, and uncertainty of course to be followed, to attempt a "fix" on a post-war service plan. But it would be even more unwise to have no plan at all, and the foregoing briefly outlines at least one plan sufficiently flexible to enable a shift in almost any direction prompted by general aviation developments.

Attaining Bearing Cleanliness

(*Continued from page* 140)

it exceed 0.1 percent. This alkali content is usually automatically maintained by "carry over" from the cleaner solution. A simple means of checking this content is to observe parts being rinsed. If parts dry with traces of light rust, the alkali content is too low; if they dry with noticeable powdery residues, alkali content is too high.

13. Rinse parts immediately after reasonable drainage of cleaner from surfaces. Do not permit cleaner to dry on parts because this makes adequate rinsing more difficult.

14. Immediately dry parts with blasts of prepared compressed air or by placing in an oven, as specified in the discussion on drying.

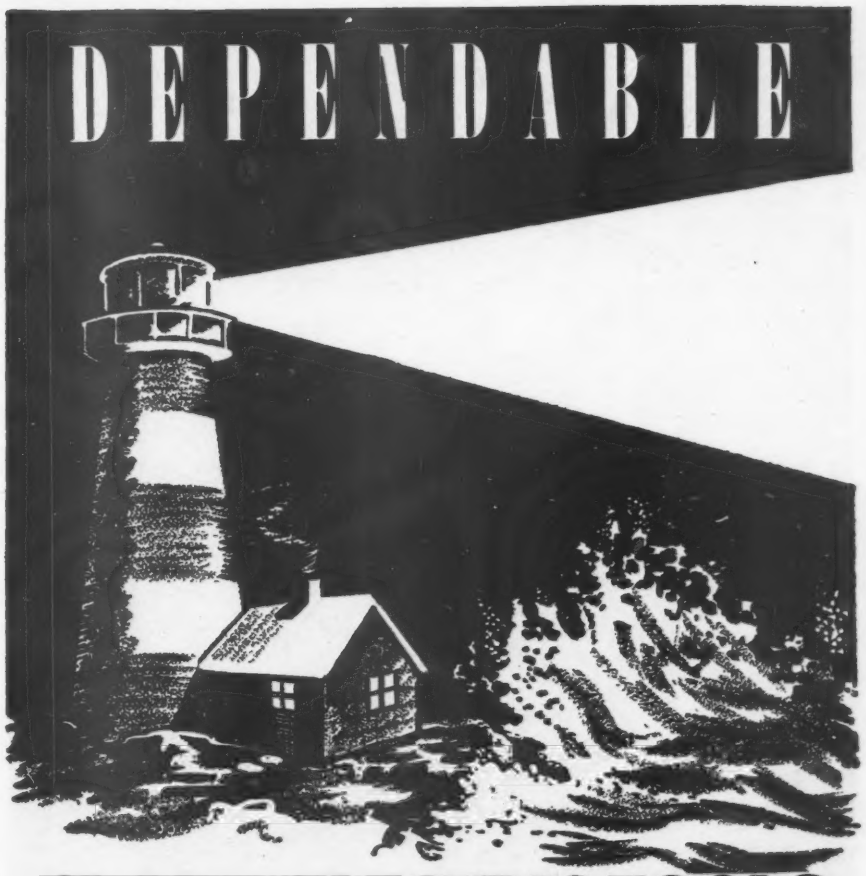
15. Apply the proper corrosion preventive, as soon as possible, to thoroughly dried parts. A thin temporary preservative should be applied on bearings before inspection.

Emulsion Spray Cleaning

Emulsions containing soluble oil can be used in the same way as alkaline cleaners. Be sure to study the particular methods of mixing given by the manufacturer of the oil used in the emulsion. The emulsions will only work with certain types of dirt, and should not be expected to act as a cure-all for all contaminants.

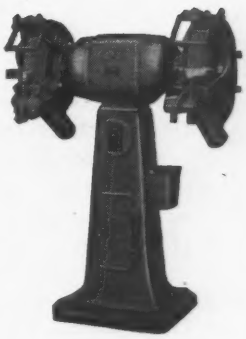
Certain precautions should be followed in the employment of these emulsions:

1. Use emulsion spray cleaning *only* on individual rings, balls, or retainers, and not on assemblies because of diffi-



CLARK ELECTRIC TOOLS

No previous use or abuse has tested the dependability of drills, grinders and sanders as has the quickened tempo of modern war production.



The record of Clark Tools is an achievement. Hour-after-hour performance . . . even beyond their expectant useful life . . . has been the experience of those who have used these tools.

When you buy a *Clark* Electric Tool, you are purchasing *dependable* performance.

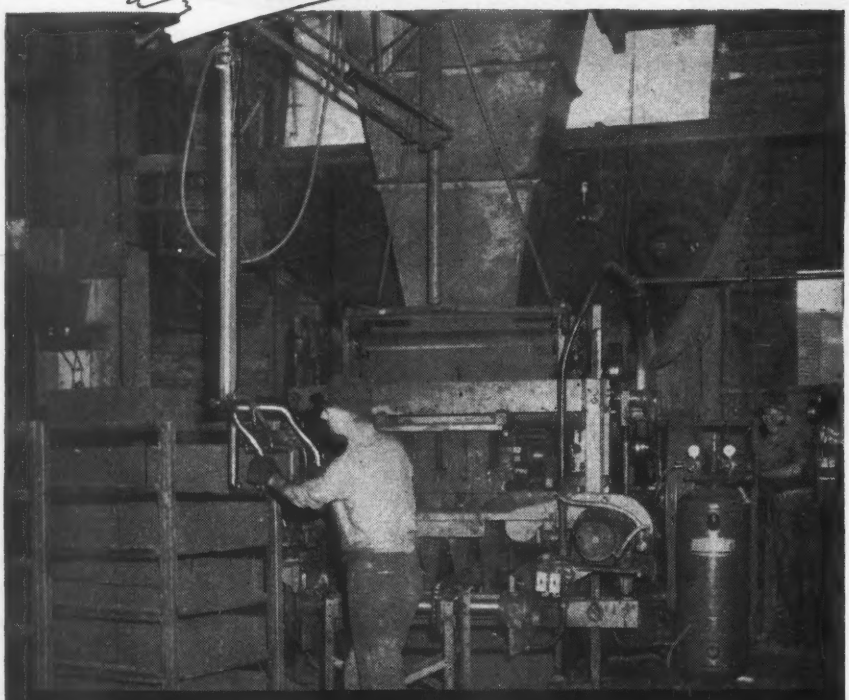
drills • grinders • sanders

"first in the field" CLARK Electric Tools

JAS. CLARK, JR. ELECTRIC CO.

612 BERGMAN ST., LOUISVILLE, KY.

Reduce Handling Costs —Speed Production



with **CURTIS AIR HOISTS**

Illustrated above is an application of a Curtis Air Hoist used to off-bear concrete blocks. In hundreds of other uses, for any lifting operation, Curtis "One-Man"—or "One-Woman"—Air Powered Hoists provide faster, more accurate lifting; they release men for other jobs, reduce worker fatigue, and save time and money.

Having less dead weight than other types of power hoists, Curtis Air Hoists permit light supports and easier moving of trolley mounted models. They are immune to over-loads and can be operated by any man or woman in your plant. Faster, yet little more expensive than a chain block.

Curtis Air Hoists are available in capacities up to 10 tons—pendant or bracketed types. For suggestions as to how Curtis Air Hoists can speed up your production and lower your handling costs, write for full information and for free, handy booklet, "How Air Is Being Used in Your Industry."

CURTIS
ST. LOUIS
NEW YORK
CHICAGO
SAN FRANCISCO
PORTLAND

CURTIS PNEUMATIC MACHINERY DIVISION
of Curtis Manufacturing Company
1957 Kienlen Avenue, St. Louis 20, Missouri

Please send me booklet, "How Air Is Being Used in Your Industry."

Name.....
Firm.....
Street.....
City.....State.....

culty of properly drying the assembly.

2. Do not handle parts with bare hands during and after cleaning and preservation.

3. Use the emulsion at temperatures which will not cause "breaking" of the emulsion or deterioration of surface active agents. The temperature recommendations of the manufacturer should be used. Temperatures between 150 and 180 deg. F. are usually satisfactory.

4. Emulsion cleaners should be made up and controlled according to the manufacturers' recommendations, which will usually be from 1-10 percent emulsion solvent in water, depending on nature and amount of contamination to be removed.

5. The emulsion tank should be dumped and refilled with fresh emulsion whenever cleaning becomes unsatisfactory.

6. The spray pressure should be sufficiently strong, and nozzles so placed and directed, that all surfaces of parts are reached.

7. The emulsion recirculating system should be equipped with filters, which should be cleaned daily.

8. Inspect machines at least weekly to see that nozzles are properly directed and not clogged.

9. If conveyor cleaning equipment is used, place parts in a position to permit sprayed emulsion to reach all surfaces.

10. Dry (as specified in item 14 under "Alkaline Cleaning Solutions").

11. Apply proper corrosion preventive (as specified in item 15 under "Alkaline Cleaning Solutions").

Emulsion Soak Cleaning

Emulsion soak cleaning is sometimes used as a preliminary to solvent cleaning. Such solutions are prepared for the purpose of removing materials insoluble in solvent but soluble in water solutions such as perspiration. Ordinarily, bearings or other parts would be immersed in a tank of soluble oil solution and allowed to soak for a period of 10-15 min.

1. When cleaning is by manual means, agitation and brushing will speed and improve the operation.

2. After proper soaking period, remove parts from tank and drain all excess solution back into tank. This will usually require not more than 30 sec.

3. Hang the parts in, or pass them through, a cold water spray, until all emulsifiable solvent is flushed away. It will be sufficiently removed when there is no further milky mixture on the surface of the part.

4. Immediately transfer parts to a hot water rinse for 30-60 sec. After removal from this rinse, water-breaking (uneven and discontinuous flow

from surfaces) will be noticed. In this case it is not an indication that parts are not clean but that there is a trace-film of solvent and emulsifier left on the surface.

5. Drain or shake off excess rinse-water.

6. Immediately dry parts (as previously specified).

7. Apply the proper corrosion preventive (as previously specified).

Petroleum Solvent Cleaning

Petroleum solvent cleaning is one of the most common methods applied to bearings. The solvent should be a neutral water-white petroleum distillate. The most common has a minimum flash point of 105 deg. F. and is sold as Stoddard's solvent or dry cleaner's naphtha as covered by Federal specification PS-661. Alternate solvents, such as kerosene, gasoline, and light petroleum oils, can be used when this material is not available.

These petroleum solvents dissolve oil on the bearings, and leave a slight oily residue along with insoluble particles on the surfaces.

The simplest method of application is with a tank in which bearings are allowed to soak and from which they are later removed, if necessary, with agitation or brushing. They are then rinsed in a tank of clean solvent, allowed to drain, and surplus solvent blown off with clean dry air. A sprayer system of washing and rinsing can be used in the same way as described for emulsion spray cleaning.

Further factors, methods, and applicable precautions in solvent cleaning:

1. This procedure is particularly adaptable for cleaning by hand in small tanks.

2. When automatic conveyor applications are made, agitation of the solvent should be provided to aid cleaning.

3. Wear oil-resisting synthetic rubber gloves or use suitable hand-protective cream when handling parts during and after cleaning, to protect hands from inflammation or dermatosis, and parts from perspiration. After drying, parts should not be handled with bare hands.

4. Handle parts on hooks, racks, or in baskets suitable for satisfactory solvent application and adequate drainage.

5. Handle solvents in safety tanks and provide fire extinguishers, since solvents are inflammable.

6. Provide tight-fitting metal covers for tanks, and keep covers in place when solvents are not in use, to minimize evaporation and contamination.

7. Use solvent at room temperature.

8. Check solvent for dirt.

9. Replace solvent when contami-

"Jeeps"
STAY ON THEIR FEET BETTER
because of Harris
COMPRESSED RUBBER BEARINGS
Jeeps are the "toughies" of all U. S. transportation units because most of their mileage is piled up on the rough, shell-scarred battlefields. They take a terrific amount of rough going but much of that is being smoothed out by Harris compressed rubber bearings for shock absorbers.
These Harris bearings permit freedom of motion in all directions, eliminating squeaks and rattles and prolonging the life of the shock absorbers. Regardless of which way the Jeep lunges, backward, forward, or sideways, the Harris rubber bearings help to control and cushion the motions in all directions, adding considerably to the stability, control, and operation of the car.
Harris Products Company are the originators of Torflex bearings, vibration eliminators, mountings, flexible couplings, and other vibration eliminator units.
The same creative engineering skill, experience and unsurpassed manufacturing facilities that produce these units will be available to industry at large when peace is declared.
HARRIS PRODUCTS COMPANY
Specialized Rubber Engineers and Sole Manufacturers of-
Duflex VIBRATION INSULATORS (MOUNTS)
Torflex BEARINGS
Torflex COUPLINGS
HARRIS COMPRESSED RUBBER BEARINGS
HARRIS
PRODUCTS COMPANY
CLEVELAND 4, OHIO, U.S.A.

nation causes unsatisfactory cleaning or reaches 2 percent of solvent volume. Dirty petroleum solvent may be reclaimed by distillation and re-used. For reclamation of small quantities, simple equipment such as a dry cleaners' still is satisfactory. Bigger stills are available for large reclamation.

10. The dirt content may be determined by evaporation of a predetermined amount until only oily or solid residues remain and then weighing or measuring the residues.

11. The solvent from the second (rinsing) tank should be transferred to the first (cleaning) tank whenever the solvent in the first is removed because of high dirt content, and the second tank is then made up with clean solvent.

12. In transferring parts, drain as thoroughly as possible to avoid carrying dirty solvent from cleaning tank to the rinse tank. This permits more effective cleaning with the second solvent.

13. Clean parts by immersion or spraying in petroleum solvent. Cleaning periods should be sufficiently long to insure complete removal of contaminants, but never less than 1 min.

14. Brush or scrub parts when necessary to aid and speed cleaning.

15. For tank cleaning, immerse parts in a second tank of clean petroleum solvent (agitate if possible) for at least 1 min. This tank of clean solvent should be used to remove only the film of contaminated solvent remaining after immersion in first tank. All solid or oily contamination, as such, should have been removed in first solvent tank.

16. After cleaning and rinsing, allow bearings to drain thoroughly, and blow off excess liquid with clean, dry, compressed air.

17. Apply proper corrosion preventive (as previously specified).

Vapor-Degreasing Solutions

Chlorinated hydrocarbons are used in vapor-degreasing equipment. These solvents readily dissolve oils, waxes, fats, etc. from contaminated surfaces. However, some mechanical force, such as spraying, agitation, etc., must be incorporated in the equipment to remove dirt, metal chips, and other particles which might otherwise remain on the surface of bearings or parts.

Do not clean damp or wet parts in a vapor-degreasing machine, because moisture might decompose the solvent to form hydrochloric acid and cause corrosion.

In the purchase of the solvents, be particularly careful that the inhibited perchlorethylene, trichlorethylene, etc., which you obtain have been guaranteed by the manufacturer or meet government specification AN-T-37 or AN-O-B31a, under which they were purchased.

The ordinary method is to dip the parts in the solvent, then rinse and dry in the vapor-phase of the degreasing machine. Best cleaning results are obtained by dipping and washing bearings in the solvent, using a hose to properly force solvent through all parts of the bearings, then rinsing and drying in the vapor-phase of the degreasing machine.

The better the equipment, the better will be the result when using these solvents.

Some precautions to be followed:

1. In order to cause sufficient condensation of the solvent for satisfactory cleaning, parts should be as near as possible to room temperature when placed in the degreaser. Parts should be free from moisture to prevent possible decomposition of solvent.

2. During processing, handle parts on hooks, racks, or in baskets suitable for satisfactory solvent application and adequate drainage.

3. Parts should not be handled with bare hands during and after cleaning and preservation. Handling should be kept to a minimum.

4. The solvents used should be specifically manufactured for vapor-degreasing, and sufficiently purified and properly inhibited to prevent corrosion during or after cleaning. Use trade-name or guaranteed solvents only.

5. Maintain sufficient solvent content in the boiling chamber, to cover the heating coils.

6. Vapor degreasers should be equipped with automatic controls for maintaining proper heat input to boil the solvent, and for shutting off heat when the vapor-phase rises above condensing coils.

7. Flow of water through condensing coils, as well as heat input, should be regulated to keep surface of vapor-phase below the level of the condensing coils.

8. After the degreaser has been shut down for any period of time, water may condense on the solvent surface. This water should be removed by skimming before equipment is started. Immediately test for acid content.

9. When the machine is to be shut down, the heat should first be turned off. Water or cooling medium for the condensing coils should be shut off after the solvent ceases to boil. Do not run cooling coils too long, to avoid condensation of room moisture.

10. At least daily, check the solvent in the boiling chamber for dirt content, and solvent vapor for free acid. The free acid control is extremely important because small amounts of free acid will actually corrode any part cleaned in the machine.

11. Free acid in the degreaser may be detected by an acrid odor in or near the machine. Chemical checks should be made to detect approach to an acid condition, and corrective measures should be applied before free acid is actually formed. A quick and simple check is to vigorously shake several c.c. of solvent (condensed from the vapor-phase) and distilled water with a few drops of phenolphthalein indicator. If the indicator is pink, the mixture is alkaline; if indicator becomes colorless, acid is present.

However, a more satisfactory check is to condense a sample of the vapor-phase until 100 c.c. of liquid is obtained. Add 100 c.c. of distilled water and 4—6 drops of methyl orange indicator. Repeatedly add small quantities of 0.1 normal standard acid, and shake vigorously with each addition until the indicator changes from yellow to orange or red, and remains so on shaking for 30 sec. If the total quantity of standard testing acid added to obtain this color change is 2 c.c. or less, then an acid condition in the solvent is being approached. Corrective measures should be taken immediately.

12. If free acid is detected by chemical check or by acrid odor, immediately correct trouble before cleaning any other part. The trouble may be corrected by addition of inhibitor or alkali recommended by the degreasing solvent supplier, or by cleaning the tank and replacing with new solvent.

13. When using or cleaning degreaser tanks and equipment, exercise extreme care not to breathe the toxic solvent vapors.

14. If degreaser equipment is an open tank, cover when not in use.

15. Before removing parts from the vapor-phase of the degreaser, drain trapped solvents.

16. Permit solvent to completely evaporate from surfaces of parts before further treatment.

17. Apply proper corrosion preventive (as previously specified).

Finger Print Neutralizer

Steel parts, when touched by bare hands, often become coated with acids or salts contained in perspiration.

A large refrigerator manufacturer has run numerous tests on the effects of perspiration and the results have been made available to the Army.

Two corrosion test panels were prepared simultaneously by cleaning, sandblasting, and handling with clean gloves or forceps. One was contaminated with one drop of synthetic fingerprint solution and dried in an air blast at 250 deg. F. Both panels were immersed in hot petrolatum so that a

coating of approximately 1/16 in. was obtained, cooled to room temperature, placed in the same humidity cabinet maintained at 100 deg. F. and 100 percent humidity, and observed at regular intervals until signs of rust appeared. It was noted that the contaminated panel corroded before the clean panel.

Similar sets of two panels were prepared, with one panel of each set contaminated with synthetic fingerprint solution. After drying, both panels were coated with rust-preventive compound, exposed to humidity, and observed as before. It was indicated that fingerprint stains are not neutralized or removed but continue to react under the rust-preventive coating and decrease the protective life of the compound. This leads to the conclusion that the best preservative applied over a dirty surface is practically worthless.

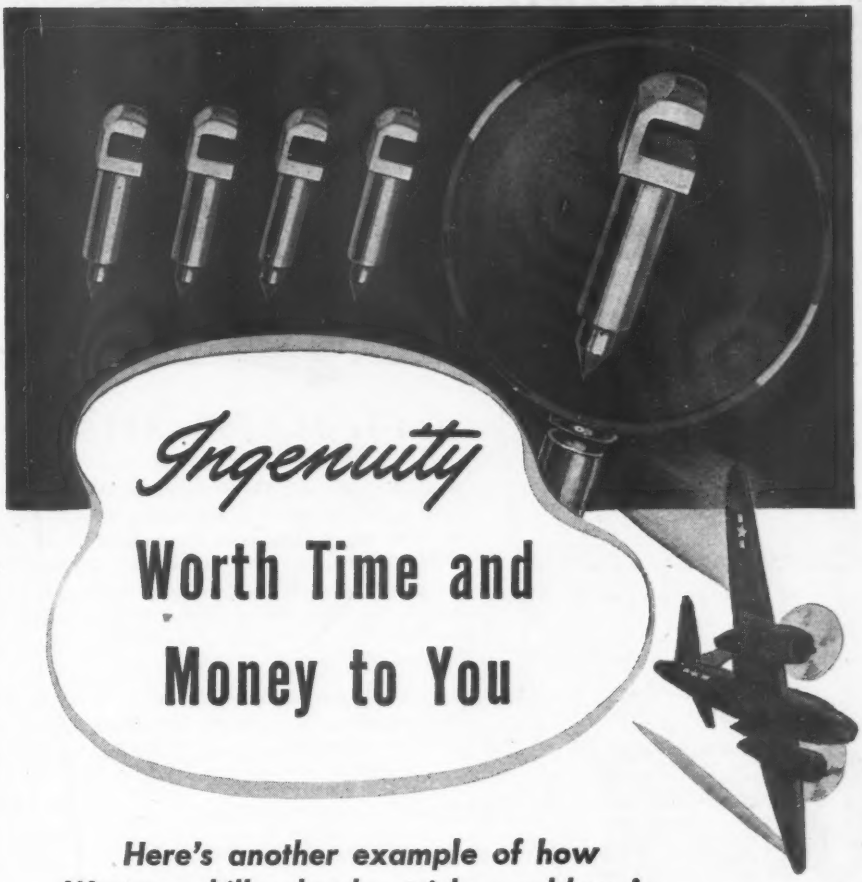
Tests were then run to determine whether ordinary cleaning materials would remove perspiration effects. Immersion cleaning of one clean and one contaminated panel with Stoddard's solvent preliminary to the application of 100 percent petrolatum and humidity testing indicates that the fingerprint shows up readily during the test.

Similar panels cleaned by vapor-degreasing with trichlorethylene showed no effect on fingerprints.

With both panels cleaned using 6 percent soluble oil solution, no fingerprint appeared, indicating that this water solution counteracts fingerprint effects. Alkaline water solutions also neutralize or remove fingerprints.

In order to overcome the fingerprint effect, second washing and rinsing solutions were tested to follow the petroleum solvent or vapor-degreasing operations. Two methods appeared satisfactory—the use of methanol containing 5 percent water for removing fingerprints, and temporary rust-preventive containing 5 percent moisture. The use of these materials indicates that petroleum solvents and degreasing liquids do not counteract fingerprints, but alkaline solutions, emulsions, 95 percent methanol, and 95 percent temporary rust-preventive do neutralize fingerprints.

Fingerprint removal has, therefore, complicated the cleaning picture. In summarizing, it appears that alkaline water solutions or oil emulsions are to be preferred for cleaning of individual bearing parts, such as rings, balls, retainers, etc. This eliminates any contamination caused during early handling by machine operators, or inspectors. The difficulty of using such cleaners arises from the possibility of moisture remaining on the parts. Therefore, any equipment using these solutions should contain areas for dry-



Ingenuity

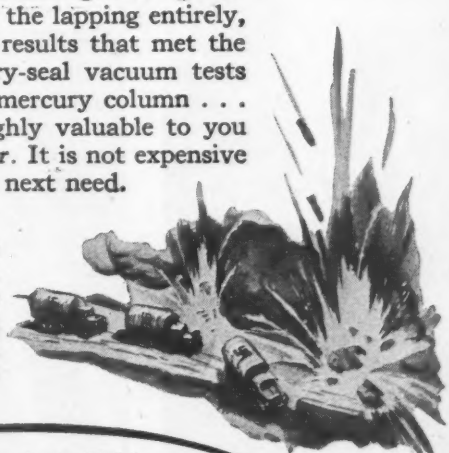
Worth Time and Money to You

Here's another example of how Western skill solved a tricky problem in aircraft small parts-making

● It's an airplane carburetor float needle and of course it must work perfectly — nothing less will do. But when it was lapped at assembly with its mating piece, the abrasive action wore a tiny groove at the seating line. Not good in a plane that's miles from its base chopping up Nazi transport — it would have a tendency to stick. But Western engineers worked out an ingenious grinding operation that eliminated the lapping entirely, with smooth finish precision results that met the specification of individual dry-seal vacuum tests — airtight support of a 10″ mercury column . . . This kind of skill can be highly valuable to you now, *but especially postwar*. It is not expensive — get our quotation on your next need.

Western Service is Complete

We manufacture special precision screw machine products to specifications. Machine capacity ranges from 1/8″ to 4 5/8″ round, with complete equipment for all types of secondary and processing operations, including precision grinding, heat-treating, hardening and pentrating.



Aircraft Products Division

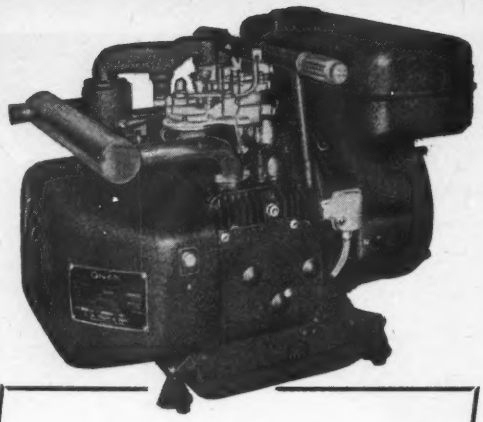
Western Automatic Machine Screw Company

Elyria, Ohio, U. S. A.

Precision Parts and Assemblies Since 1873

ELECTRICITY

TO MEET AVIATION AND AIRCRAFT INDUSTRY POWER NEEDS



ONAN ELECTRIC GENERATING PLANTS provide reliable, economical power for many applications in the aviation industry. Available in 65 models including Airborne, lightweight, compact types. Powered by Onan-built gasoline engines, these electric plants are of compact, single-unit design. Built for heavy duty service, stationary or mobile.

●

Successfully used by Pan American Airways—Northwest Airlines—Western Airlines—U. S. Army Air Forces—Air Transport Command—Royal Canadian Air Force.

D. W. ONAN & SONS

3127 ROYALSTON AVE.
MINNEAPOLIS 5, MINN.

ELECTRIC PLANTS
Onan
POWER AND LIGHT FOR EVERY NEED

350 to 35,000 WATTS

Models range from 350 to 35,000 watts. A.C. types from 115 to 660 volts; 50, 60, 180 cycles, single or three-phase; 400, 500 and 800 cycle, single phase; also special frequencies. D.C. types range from 6 to 4000 volts. Dual voltage types available. Write for engineering assistance or detailed literature.

Supply power for starter energizing . . . radio navigation . . . battery charging . . . communications . . . cabin heating . . . airport and general lighting . . . electrical repair tools . . . aircraft accessories . . . many other applications.

Model shown is from OTC light-weight series.

EVERY STEP TAKEN IN *Safety!*

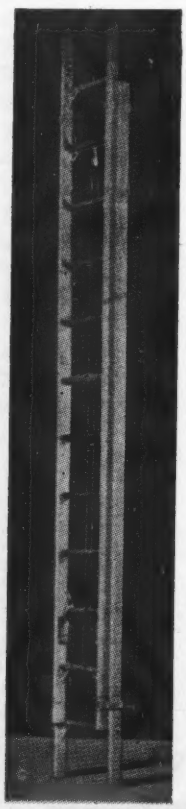
Gold Medal
Safe Ladders and Scaffolding for Every Purpose

Gold Medal Safety Platform Ladders

Wide working platform, tool rack at top, rung back, steps knee-braced and truss-rodded. Sizes 5' to 20' overall.

Gold Medal Mechanics' Step Ladder

Heavy Duty rung back, step double reinforced with trussed tie-rod and knee-braces. Safety spreaders. Sizes 3' to 20'.



Gold Medal Safety Extension Ladder — Automatic Spring Lock, Rope & Pulley — Durable guide iron — sizes 16' to 52'.

THE PATENT SCAFFOLDING CO., INC.

1550 Dayton St., Chicago 22, Illinois · 3821—12th St., Long Island City 1, N. Y.

ing and the application of a temporary rust preventive. This would allow parts to be in the ordinary factory or assembly department for a period not to exceed two weeks before danger of rusting arises.

When assembled parts or individual pieces are cleaned using either petroleum solvent or vapor-degreasing equipment, a second solvent rinsing should be incorporated in the process. This means that the rinse should be done on the dry parts using 95 percent methanol, 95 percent temporary rust-preventive, or some similar oil-soluble soap solution which would neutralize fingerprint effects. The bearings or parts should then be dried a second time and coated with a thin temporary rust-preventive compound preliminary to inspection or further handling.

After bearings or parts have been cleaned by any of the solutions or solvents mentioned, they must be thoroughly dried to remove all traces of moisture or solvent. In all equipment except vapor degreasers, it is preferable to blow off excess solvent or solution with clean, dry and filtered compressed air. If this blow-off does not thoroughly dry the parts, they should be dried in an oven or hot air blast. Wiping with clean cloth should be done only when it is impracticable to use an air blast or oven.

The presence of moisture in compressed air may be readily detected by permitting the air to blow on a polished metal part at room temperature, and observing for condensation. Moisture from traps in airlines should be dumped daily.

Moisture or solvent trapped in bearing pockets, preliminary to oven-drying, may cause corrosion during drying. Oven temperatures should not exceed 250 deg. F., since higher temperatures might temper the steel.

It is important that the cleaning department be coordinated with the unpacking, inspection, and repair department, to keep production in balance. Otherwise, bearings will accumulate at some step in the process, or part of the equipment will have idle time.

As soon as the total quantity of bearings to be processed is fixed, economical lots should then be determined—meaning that the sizes of baskets which can be used in the cleaning equipment should be decided. The same sizes can be used in hand-operated tanks or elaborate conveyor cleaning systems. In either case, best results are obtained when baskets contain not more than two layers of bearings, and preferably one layer. Perforated metal baskets will last longer than wire mesh baskets but may not give as efficient results. Shapes and styles of handles will depend upon other equipment.

Next step in the layout is to decide upon type of solution to be used and size of cleaning equipment to be installed. Dirty bearings may require several minutes soaking time to loosen dirt, and therefore increase floor space and size of equipment. If bearings are relatively clean, only 1 or 2 min. will be required in the washing operation and the same time for rinsing and drying. Thus, the washing machine size would be estimated from the formula: Sq. ft. of cleaner=Area of bearings cleaned per day, divided by Hr. of operation multiplied by 40 for ordinary amount of dirt or multiplied by 10 for dirty bearings.

If only a small percentage of bearings are coated with hardened lubricant, it might be economical to have a special small tank in which to soak them, basing the equipment size on the regular run of bearings.

In one layout, the bearings are unpacked, assorted, and placed in baskets on a roller conveyor at one end of the room. The baskets of bearings are then sent to the cleaning machines, rinsed, dried, and coated with temporary rust preventive preparatory to inspection.

For small shops, hand-operated tanks and tables are satisfactory for cleaning, rinsing, and applying rust preventive. Baskets of bearings are soaked and slushed in the solution, allowed to drain, and moved to the rinse tank, where the procedure is repeated. Then the operator should blow-off or oven-dry the bearings before coating them with temporary rust preventive using a similar tank and drain board.

For larger shops, continuous conveyor washing machines are more economical.

If bearings have been touched by bare hands, a dip in methanol or fingerprint neutralizer solution, and drying, should follow the conveyor cleaning and drying operation. In either case, bearings should be coated with this temporary rust preventive preliminary to inspection.

Many operators prefer the use of vapor-degreasing equipment for cleaning bearings. A review of remarks given previously on the purchase of the solvent, handling of bearings, and care of equipment, would be relevant. Bearings are placed in the vapor-phase, where the solvent collects on them. When the dirt is loosened, the basket of bearings should be slushed in the liquid or washed off with a nozzle. Finally, the bearings are returned to the vapor-phase for rinsing, and raised slightly for drying. Again, if bearings have been touched with bare hands, a dip in methanol or fingerprint neutralizer solution, and drying, should follow the degreasing and cooling. Finally, the temporary rust preventive should be applied.

The necessity for, and use of, a demagnetizer was discussed previously.

As mentioned earlier, dipping, spray washing, and vapor degreasing are not reliable for thoroughly cleaning bearings. Minute solid particles may get caught between the retainers and balls or rolls. When hard particles fall into the ball path they might lock the bearings, causing rejection during inspection or indenting the races to cause early failure.

A bearing washing machine wherein the petroleum solvent is forced through the bearing and tends to remove any hard particles between retainers and balls or rolls, has been developed by the Air Corps, which suggests that it be used just preliminary to inspection. The bearings should be cleaned at time of inspection, or might have a thin film of solvent to help prevent corrosion during inspection. Bearings that seem to catch or run unevenly during inspection could be rewashed in the machine and reinspected to determine if dirt particles were the cause of the catch.

When an inspector questions whether a bearing is properly cleaned, he can test its cleanliness as follows:

Obtain an evaporating dish (approximately of the same diameter as, or larger than, the bearing), a 500 c.c. Ehrlenmeyer flask fitted with a two-hole synthetic rubber stopper, and two glass tubes. One tube should be L-shaped and extend through the stopper only a short distance into the flask; the other glass tube can be L-shaped and reach nearly to the bottom of the flask. Fill the flask with clean petroleum solvent, or its equivalent.

Proceed by holding the bearing over the evaporating dish, and spin outer ring while inner ring is stationary. Pour solvent through the bearing into dish, using short glass tube. Finally, spin outer ring in dish of solvent. Remove bearing and swirl solvent to collect dirt particles in center of dish. The presence of metal particles, scale, or other hard particles indicates that the bearings should be cleaned.

In a doubtful case, the solvent in the dish could be filtered and the paper examined for hard particles. Be sure to filter solvent before re-use, else discard it and obtain clean solvent for each bearing examination.

This completes the washing before inspection. The clean bearings or those coated with rust preventive should be moved in baskets, with tongs, or by gloved hands, but never touched by bare hands. If the temporary rust-preventive interferes with inspection, it can be wiped off with a lint-free clean cloth.

TENSILE breaking strength as great as 1016 pounds per 2-inch width was observed during laboratory tests of 2″ x 10″ strips (0.375″ to 0.5″ thick) of six different Booth felt types.

Almost any desired combination of qualities . . . durability is only one . . . are obtainable through the *controlled* manufacture of Booth "prescription" felts and precision die-cutting into mechanical parts. Read Booth's "Technique of Felt Making."

THE BOOTH FELT COMPANY
482 19th Street Brooklyn, N. Y.
745 Sherman Street Chicago, Ill.

APPLICATION CHART AND SAMPLE KIT . . . Contains swatches of S.A.E. felt types, with specification tables. Write for it. (No sales follow-up.)

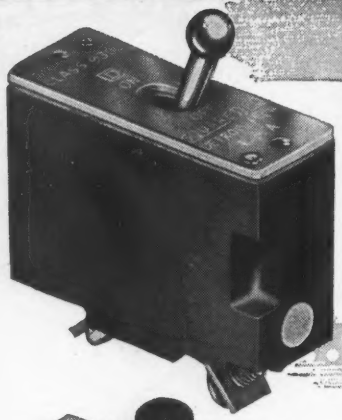
2075

Booth
TRADE MARK

PRECISION CUT FELT PARTS

SQUARE D OFFERS CIRCUIT BREAKERS TO MEET "AN" REQUIREMENTS

for aircraft, radio, boats, panels and other equipment requiring control and protection — 5 to 50 amperes — 30 volts D.C.

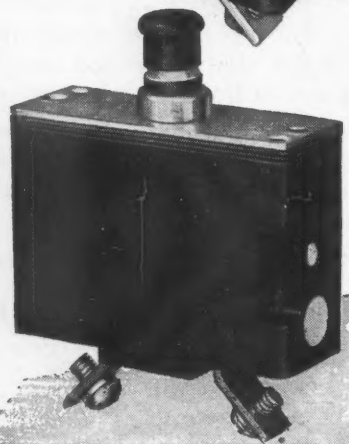


SWITCH BREAKER Class 9301 · Type B (AN 3160)

Combination TOGGLE SWITCH AND CIRCUIT BREAKER used in Aircraft and other applications on low voltage circuits definitely requiring *both switching and protection* against short circuit and overload. Available with or without luminous handle tip.

PUSH BREAKER Class 9310 · Type A (AN 3161)

Developed to provide ONLY CIRCUIT PROTECTION on low voltage circuits where switching is not required. Unit can be opened only by reason of short circuit or overload after which it is manually reset to again establish the circuit. The manual reset button, black at top, is provided with a red band to indicate trip in daylight and a luminescent band to indicate trip in darkness.



PUSH-PULL BREAKER Class 9311 · Type A (AN 3161-P)

Provides SWITCHING AND PROTECTION similar to 9301 except that manual "on" and "off" is Push-Pull—not Toggle. Push-Pull tends to protect against accidental or careless operation of vital circuit, yet provides a manual means of operation for service. The manual reset button, black at top, is provided with a red band to indicate trip in daylight and a luminescent band to indicate trip in darkness.

SPECIFICATIONS: AMPERE RATINGS—5, 10, 15, 20, 25, 35, 50 amperes. VOLTAGE—Up to 30 volts D.C. SHORT CIRCUITS—1500 amperes at altitudes up to 40,000 feet. VIBRATION—Withstands frequencies varied from 10 to 55 cycles per second at 1/32" amplitude (1/16" total excursion). SHOCK—Deceleration force of 18 G does not cause malfunctioning. AMBIENT TEMPERATURE RANGE—Thermal: 50° to 135° F.

• Square D aviation equipment is exported through AVIQUIPO, INC., 25 Beaver Street, New York 4, New York

SQUARE D COMPANY

DETROIT • MILWAUKEE • LOS ANGELES

Service Snafu

(*Continued from page* 151)

is exhausted—unsatisfactory reports, manuals, blueprints, technical Orders, photographs, and manufacturers' handbooks. Contacts are made with departments in the local Douglas plants—engineering, service, flight, and manufacturing—and, if necessary and if practicable, with the manufacturer of the part affected.

When the service liaison engineer has completed the article, it is sent, along with the source material, through the checking system. The first stop is the art editor's desk, where the type of illustrations necessary for the clearest presentation of the story are decided upon in conference with the service liaison engineer. Usually most of the drawings and photographs to be used have been accumulated during the investigation. The art editor sends the basic material to an illustrations group for making of the finished drawings.

The article is then sent for rewriting to technical writers, who check it against the source material and edit it for clarity, organization, grammatical construction, and completeness. Then it is submitted for technical check to either the editor or another service liaison man to make sure that all possible points have been covered. The author of the article then checks it with the technical writer to approve all revisions and to answer any questions.

When the staff is satisfied with the article, it is sent for approval to the customer service, engineering, and experimental departments at the plant which has been building the model affected. Additional copies go to any other Douglas departments concerned with the subject and to local parts manufacturers contacted. All articles on flight technique or on the actual operation of the airplane are referred to the chief pilot and his staff.

When the approval copies have been returned, the service liaison engineer incorporates the revisions necessary and checks thoroughly any controversial statements. The technical writers check the insertions or deletions; and when the staff is agreed on all changes, the article is ready for publication.

During this evolution of the finished story, the art work has been moving through its own cycle of development. While the illustrations are being drawn, the art editor and the writer decide upon the typography to be used on the art. When the original art work is returned, the type is applied, and the drawing, along with reference material, is submitted for staff approval. The service liaison engineer, the technical checker, and the technical writer check each illustration for accuracy, completeness, and effectiveness of presentation and note their suggestions and corrections on a routing sheet (such as that shown at the beginning of this article). The corrections are made and the revised illustration is circulated until all the checkers OK it.

When the engraver's proofs are returned, they are routed in the same manner, and the service liaison engineer writes the captions to be used with the illustrations.

At this stage, article and art work have reached completion. Although the system sounds very complicated, it is absolutely essential to prevent errors and maintain the standards established for the magazine. And it is faster than the steps involved might indicate.

Distribution

Of course, no amount of careful investigation, writing, editing, and checking would be of value if the information failed to reach those who need it. Not only does *Douglas Service* go to Army, Navy, and Marine personnel, but to all the airlines operating Douglas equipment. A special overseas edition (on lightweight paper where weight is a deciding factor) has also been added.

To assist the manufacturers of component parts, circulation to them is being increased and distribution is also being extended to the producers of lubricants and fuels.

Plans for Future

Now with reconversion of wartime models and the attendant problems looming, the staff is prepared to publish complete information on this subject, too, and will attempt to anticipate many of the questions sure to be asked by operators.

As a means of increasing the usefulness of the magazine, it has been decided to reserve certain pages for service information furnished by the manufacturers of component parts of Douglas aircraft. This new feature will appear in the forthcoming Jan. 1945 issue of *Douglas Service*.

Planning Payloads

(*Continued from page* 186)

spotty and may easily be side-stepped. The area of this activity at the flight altitude in this particular case is quite large.

At an average airspeed of 140 knots, and an hourly fuel consumption of 150 gal., our assumed 30-mi. track deviation may be represented by 192 lb. of fuel.

Avigational Errors

It is inconceivable that an avigator, no matter how good, will be able to adhere exactly to his plotted track. In

Outstanding

NEW IMPROVED CESCO HELMETS

● At a time when welders need superior equipment, CESCO announces a new, improved line of welding helmets.

These newly designed helmets are sturdier and simpler and have many fool-proof features.

Safety engineers give them unqualified approval. Welders who have tested them say they can't be beat for comfort. (That's an "earmark" of all CESCO head and eye safety equipment.)

AVAILABLE NOW!

Increased production permits offering these helmets immediately. Write today for your copy of CESCO'S NEW enlarged Welding Catalog.

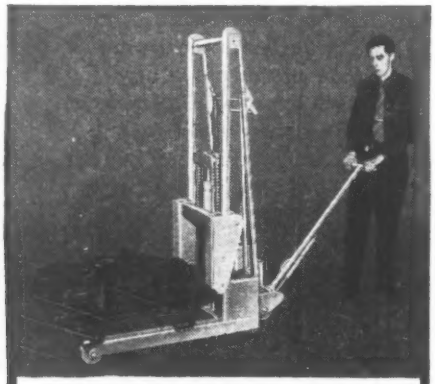
CESCO

CHICAGO EYE SHIELD CO.
2321 Warren Boulevard
Chicago 12, Illinois

CESCO FOR SAFETY

LYON-Raymond
Hydraulic
HIGH-LIFT TRUCK

1. TRANSPORTS SKIDS
2. TIERS MATERIALS
3. POSITIONS WORK



New tubular construction makes it light, easily handled—and STRONG.

A FEW of ITS MANY USES:—

- Positions dies for easy, safe handling in and out of presses.
- Holds stack of sheets at proper height for easy feeding to machine.
- Adjustable support for overhanging work—at drill presses, shears, punches.
- Positions work at proper heights for transfer.
- As a work table — always at proper height for each workman.
- Places and holds heavy work exactly where needed for machines.
- Loads and unloads motor truck shipments—level loading at truck or platform—transfers at places where overhead systems can't reach.

For the complete details of this adaptable, labor-saving cost-cutting, truck, write today for Bulletin 136. It's free for the asking.

LYON-Raymond Corporation
Material Handling Equipment
394 Madison St., Greene, N. Y.

avigation, first you must determine where you were and then set a compensating course. Avigational accuracy will vary with the seasons and also in various quarters of the globe.

For our purpose here, however, we must assume a reasonable error for a 3,000-mi. trip, and experience indicates that it will be approximately 80 mi. At the previously mentioned airspeed and consumption figure, extra fuel in the amount of 500 lb. would be required. This is only true, of course, where distances and conditions are such that celestial avigation is used.

The chart may illustrate a condition of maximum opportunity for avigational error. Flight through the frontal activity from (A) to (B) would provide the best celestial fix possibilities. However, should the captain decide to descend and proceed through at a level of 3,000 ft., the possibilities of obtaining fixes for the distance (A-B) would be remote. At the lower level, then, dead reckoning would necessarily have to be used for over 1,000 mi.

Fuel Aboard Not Usable

Payload and reserve curves prepared by the manufacturer rarely include the factor of "fuel aboard not usable." Actually, the amount allotted depends upon how the aircraft is to be flown. This fuel should be that amount unavailable when the aircraft is flown in an endurance condition—minimum safe airspeed at minimum altitude or high trim angle. For qualifying purposes in this case we will set aside 30 gal. or 180 lb. For weight accounting purposes this is usually allotted to the basic weight of the aircraft.

A clearance at 8,000 ft. for 3,000 mi. may put you over the top the entire distance; more often not, however. If not, the avigator may require several climbs for the purpose of taking a sight. A prudent allotment would be a fuel allowance for two climbs from 8,000 to 12,000 ft. or approximately 125 lb. of fuel. This amount is over and above that required in level flight.

During flight tests for speed-power determination, movement aboard the aircraft is held to a minimum. In scheduled operations on commercial aircraft of a size that might fly 3,000 mi. passenger movement must be expected. This movement will be reflected in airspeed loss for a given hp. by loading the automatic pilot (which is energy-consuming), or if the ship is trimmed on the automatic pilot at all times, will be reflected by extra elevator or tab drag. Let us evaluate a 2-knot loss in airspeed over the entire distance at the average hp. This, then, would require approximately 165 lb. more fuel.

In these days of long-range flight planning, each operator should set his own standards of aircraft comparisons. Basic performance information should be requested from the manufacturer and then methodically reworked into practical operating data. Only by this method may reliable comparisons be made.

More so than ever before, it is realized that conscientiousness on the part of the captain and ability supplied by a flight engineer comprise a most valuable economic asset enroute. A successful long-range operation does not merely mean arriving at the destination but involves, also, a scrupulous technical flight-control procedure by the crew.

Thus far, items have been covered that cannot very well be controlled. Adding the losses at this point, our payload is affected as follows:

Turbulence	129 lb.
Intentional deviations	192 lb.
Avigational errors	500 lb.
Climbs	125 lb.
Fuel unusable	180 lb.
Passenger movement	165 lb.
TOTAL	1291 lb.

Some may claim, "That's why we carry a reserve". That's true, but heretofore, regulations have required reserves to an alternate beyond the destination, plus a time reserve requirement. If these factors encountered enroute are not scientifically provided for, enough fuel may not remain for the alternate.

Large fuel requirements necessitate density consideration. Unit fuel weights will vary with base, cracking process, aromatic content, and temperature. All 100-octane fuels do not weigh the same under identical temperature conditions. On a circuitous route eastbound over the North Atlantic and westbound across the South Atlantic, the northern fuel may weigh 6.00 lb./gal. and the southern 5.80 lb./gal.

If 6 lb. is considered standard, and loading is done by gallons, a 3,000-gal. fuel load across the South Atlantic will weigh 17,400 lb. rather than 18,000 lb. The 600-lb. difference is actually short-changing the pilot. It is fuel he thinks is aboard but isn't. This error, however, may be controlled by a conscientious, pound fuel-loading system which requires hydrometers at all stations.

Cruise-Control Data

(*Continued from page* 185)

vantage in that the specific fuel consumption is shown for any *bhp.*, with any *bmep.-rpm.* combination consistent with that *bhp.*

Fig. 2b shows a typical manifold pressure—pressure altitude chart for

various outside air temperatures, for constant *bmep.* and carburetor fuel-flow setting. It is important to note that the manifold pressure required to obtain a given *bmep.*, at a given outside air temperature and pressure altitude, and for a given carburetor fuel-flow setting, is independent of engine *rpm.* within the cruise-control range.

Possible effects of *rpm.* on the manifold pressure required are those of change in volumetric efficiency with change in *rpm.*, and change in exhaust back-pressure with change in *rpm.* These effects are negligible within the cruise-control range for a non-turbo-supercharged engine, and not within flight-test detection.

Fig. 3 shows typical propeller characteristics as determined by propeller manufacturers. In this curve η is plotted against J for various values of C_p.

Fig. 4 shows a curve of fuel-flow, in lb./hr./engine vs. true speed, for level flight at a given density altitude, and for various gross weights. This curve assumes a fixed carburetor setting, with *bmep.-rpm.* combinations chosen for maximum ratio of propeller efficiency to specific fuel consumption, consistent with maximum *bmep.* allowable for continuous auto-lean operation as recommended by the engine manufacturer for best engine-life.

The data required to construct curves as shown in Fig. 4 may be computed from the basic data as given in Figs. 1, 2a, and 3, or the data required may be obtained directly from flight tests. Because of the flight-test analogy, the following mathematical method is suggested when computing the data:

Assume that Fig. 4 is to be constructed for a density altitude of ρ, and for a fixed auto-lean carburetor setting. Also assume that a curve for Fig. 4 is to be constructed for a gross weight of W_1.

With these assumptions, first choose a value of V_1. With the ρ and W_1 assumed above, a value of V_{iw} may be computed. Then from Fig. 1 the corresponding value of thp_{iw} may be obtained, and finally the *thp* required may be computed. This required *thp* may be obtained in a great number of *bmep.-rpm.* combinations, but that combination which gives the highest value of η/c, taking into consideration the maximum *bmep.* allowable from the point of view of engine wear, is the proper combination to use for maximum range.

At comparatively high gross weights at the beginning of a long-range flight, experience will show that η/c maximum occurs at minimum c because of engine wear $bmep._{max.}$ limitation. Thus if a value of N is chosen such that the $bmep._{max.}$-*rpm.* combination is consistent with the propeller chart data in Fig. 3, and is at the same time consistent with the speed-power data of Fig. 1, it will usually be found that no other *bmep.-rpm.* combination need be tried. If the propeller characteristics are plotted in the form of η vs. J for various values of $\eta \times C_p$ rather than C_p, the foregoing process of determining the $bmep._{max.}$-*rpm.* combination consistent with propeller and speed-power data becomes simplified.

As an example, for any value of N, $J = V/ND$ is easily computed. Also, since $\eta \times bhp. = thp.$, $\eta \times C_p$ may be directly computed because *thp.* is known. With these values of J and $\eta \times C_p$, η may be obtained directly from the curves of the propeller characteristics heretofore mentioned. Then $bhp. = thp./\eta$ is computed, and from Fig. 2a, s.f.c., and finally fuel-flow in lb./hr./engine may be obtained. All these values may be plotted as shown in Fig. 4.

If a curve of N vs. lb./hr. were plotted for various *bmep.-rpm.* combinations consistent with the propeller and speed-power data for constant V, it would be found that the minimum in this curve would occur at η/c maximum, and that this minimum would, for the high gross weights, occur at a *bmep.* much too high when considering a compromise between good thermal efficiency (high *bmep.*, low s.f.c.) and long life for the engine. Thus, as stated before, except for the low gross weights, the maximum η/c combination allowable may be chosen immediately from $bmep._{max.}$ considerations.

In the low gross weight range, the *thp.* required for a given V near maximum-range speed is so low that the $bmep._{max.}$-*rpm.* combination occurs at such a low N that η tends to drop off appreciably. In such case, a higher ratio of η/c may be obtained at a lower *bmep.*-higher *rpm.* combination consistent with the *thp.* required for the given V.

Using the ideas heretofore outlined, the data for Fig. 4 may be computed and plotted for various gross weights. A tangent drawn from the origin, O, to any gross weight curve will determine the $[(L/D)(\eta/c)]_{max.}$ point (maximum range point) for no-wind at that gross weight. This point usually occurs at a C_L too great for proper controllability or proper automatic-pilot operation, or too close to $C_{L\ max.}$ when considered from the gust-stall viewpoint.

Thus, a line of maximum C_L allowed for good controllability and safe operation should be shown (see Fig. 4) covering all operational gross weights. In Fig. 4, constant *bhp.* lines are horizontal and constant speed lines are vertical. If the maximum range point is required for headwind conditions,

AIRCRAFT

VISION for VICTORY

with a

LIBERTY AIRCRAFT MIRROR

The pilots of thousands of Allied fighter planes, now in action over our widely scattered battle fronts, are getting a perfect image of things behind them without eye-strain or fatigue, by means of Liberty Aircraft Mirrors.

Liberty Aircraft Mirrors are all first surface mirrors, and as permanent as their glass base. They give the pilot a clean, well defined image without distortion, immediately.

Each fighter plane equipped with a Liberty Mirror has a mirror built to meet the specific requirements of that plane. Thus the pilot changing from one plane to another gets uniformly good vision at all times, in all planes.

All Liberty Mirrors are now built only for War service, but later these battle tested vision devices will be available to all operators, military, transport or private.

LIBERTY

MIRROR DIVISION

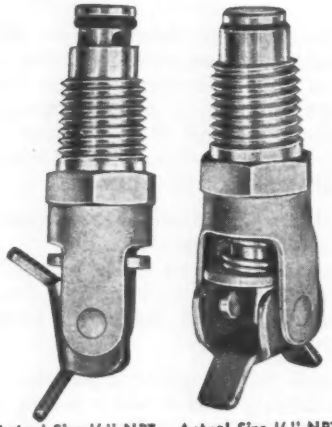
LIBBEY-OWENS-FORD GLASS COMPANY

BRACKENRIDGE PENNSYLVANIA

ARMY E NAVY

For continued outstanding production Liberty has been granted a renewal of the Army-Navy Production Award, entitling them to add a star to their "E" flag.

"No 'VIBRATION LEAKS' with this Advanced Koehler Drain Valve"



Actual Size ¼" NPT Open Position — Actual Size ¼" NPT Closed Position

REPLACES AN 771 DRAIN COCK

A.A.F. Approved . . . Winterization Approved

A fool-proof drain valve developed to save service hours — that's the Koehler K1700B Drain Valve! Dependable, strong spring action snaps to full locked open or full locked closed positions. Slow, uncertain thumb-screw adjustment unnecessary. Safety wiring eliminated. Available in all sizes. Can be used in place of Part No. AN 770 in some applications.

KOEHLER AIRCRAFT PRODUCTS COMPANY

814 Vermont Ave., Dayton 4, O.

Producers of Aircraft (Oil and Fuel) Valves since 1931.

the origin need only be shifted to the right by an amount equal to the headwind component, and the tangents may be drawn from this origin, O', which is actually a ground speed rather than an airspeed origin. The tailwind maximum range points are usually not considered practical because of the C_L-controllability safe operation limitations mentioned preceding.

Once the maximum range points have been determined for various gross weights, various altitudes (using other figures analogous to Fig. 4), and for various wind condition, maximum range may be determined by plotting mi./lb. vs. gross weight, and integrating the area under the curve. Mi./lb. may be determined by dividing mi./hr. by total lb./hr. as determined by the maximum range points.

In Fig. 4, the minimum points of the gross-weight curves represent the maximum endurance points. But these usually occur at such high C_L, it is not recommended that they be used when endurance is required, unless in case of emergency, as when waiting for weather to clear for safe landing conditions.

The shaded area *a-b-c-d* in Fig. 4 represents the auto-lean cruise-control operational boundaries. The line *a-b* represents the maximum gross weight limitation, *b-c* the maximum C_L-controllability safe operation limitation, *c-d* the gross-weight empty limitation, and *d-a* the maximum cruise-power limitation. Another way for presenting the data in Fig. 4 is to plot mi./lb. vs. true speed for various gross weights. But this method has a disadvantage in that new curves must be made for headwind conditions.

From Fig. 4 it is easily seen that true airspeed for maximum range at constant altitude increases with gross weight increase, and follows very closely a constant C_L line (usually about .8). Thus, naturally, the indicated airspeed for maximum range increases with gross weight increase at constant density altitude. But at constant gross weight, the indicated airspeed for maximum range changes only very slightly with altitude, due to the effect of altitude on $\eta/c_{max.}$.

When determining the data for Fig. 4 directly from flight test, the following technique may be used:

Let it be assumed that Fig. 4 is to be constructed for a density altitude of ρ, and for a fixed auto-lean carburetor setting. Load the airplane to a gross weight such that at the end of the climb to the density altitude, ρ, the required gross weight, W_1, will be a relatively high value. Adjust manifold pressure for $bmep_{max.}$ at any reasonable *rpm.* within the cruise-control range using torquemeters, trim the airplane for level flight, and plot average lb./hr./engine observed fuel-flow vs. true airspeed computed from observed airspeed indicator readings.

Change *rpm.*, keeping *bmep.* constant, and again plot average lb./hr./engine vs. true airspeed. When determining data for the low speed, low gross weight section of Fig. 4, be sure to check if a lower lb./hr./engine may be obtained by using a *bmep.* lower than the $bmep_{max.}$ recommended by the engine manufacturer for best engine-life.

Using the ideas aforementioned, data for Fig. 4 may be obtained for all speeds, gross weights, and altitudes.

Once a chart as shown in Fig. 4 has been determined, either by computation from basic information or from flight test directly, cruise-control information may be readily obtained for any of the following cruise-control techniques:

1. Maximum range speed.
2. Constant amount, or percent, of airspeed greater than maximum range speed.
3. Constant *bhp.*
4. Constant indicated airspeed.
5. Any combinations of the foregoing.

Then, cost and profit analyses, based, respectively, upon total flying cost computations and revenue considerations, may be completed to determine the relative economies of the various cruise-control techniques and the best block-to-block speeds for maximum profit rate per investment dollar.

Book Reviews

(*Continued from page* 208)

of aircraft, such as helicopter, rocket ship, and jet-propelled craft. Throughout, the deglamorized common-sense attitude is accented.

SEAMLESS STEEL TUBE DATA. Seamless Steel Tube Institute, Pittsburgh, Pa., 320 pages, loose-leaf binder. $2.50.

Supplying much technical information on steel tubing, this book is divided into sections, treating of general data, mechanical tubing, and pressure tubing, and there are handy reference tables.

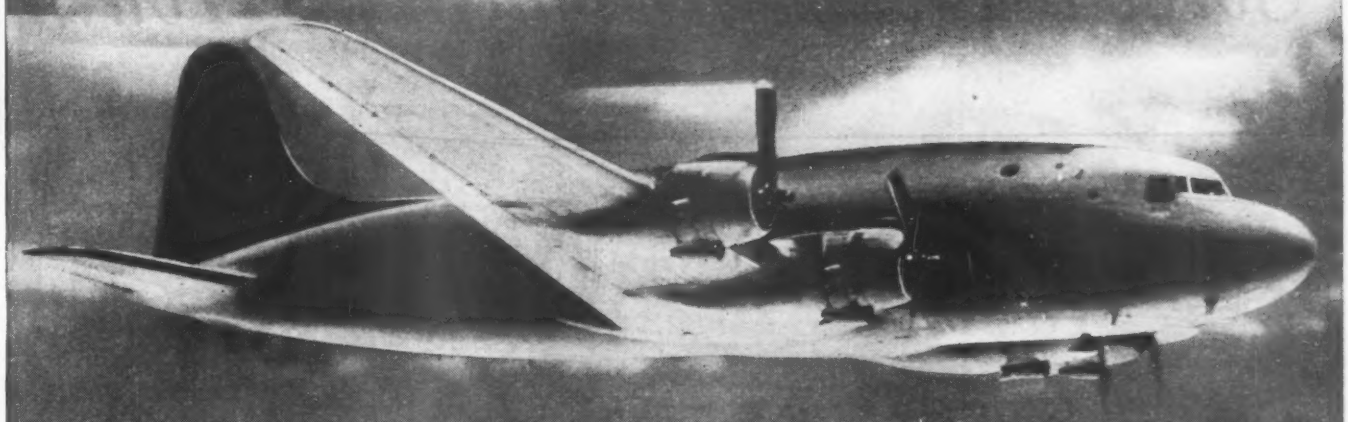
BOMBER PILOT, by Philip Harkins. Harcourt, Brace & Co., N. Y. C. 229 pages. $2.00.

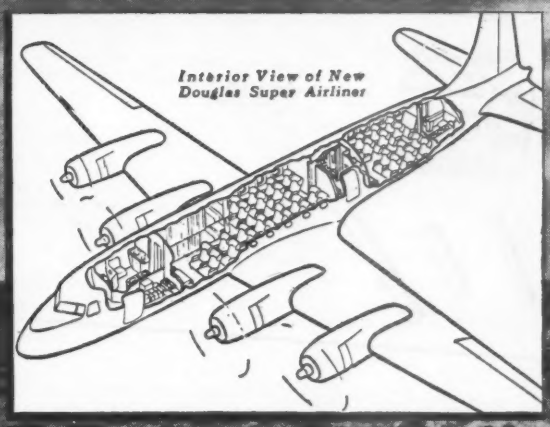
Story of an aviation cadet's progress through to the winning of his second lieutenancy and skippership of a Boeing Flying Fortress. Reflected is the tough grind which thousands of young Americans are undergoing to perfect the skills of sky combat.

COMPASS OF THE WORLD, Edited by Hans W. Weigert and Vilhjalmur Stefansson. MacMillan Co., N. Y. C. 466 pages, maps, charts, index. $3.50.

Symposium of 28 authorities in the field of geography and international politics, intended to offer a fresh perspective on the rapidly shrinking planet. Geopolitics and geography are taken apart and put together again to show their workings and the validity of the conceptions. It is stated that this book "is intended to correct some of the basic misconceptions of political geography which threaten to confuse the minds and plans of statesmen, soldiers, and the general public."

SINCLAIR 100-OCTANE FOR NEW SKY GIANTS





Interior View of New Douglas Super Airliner

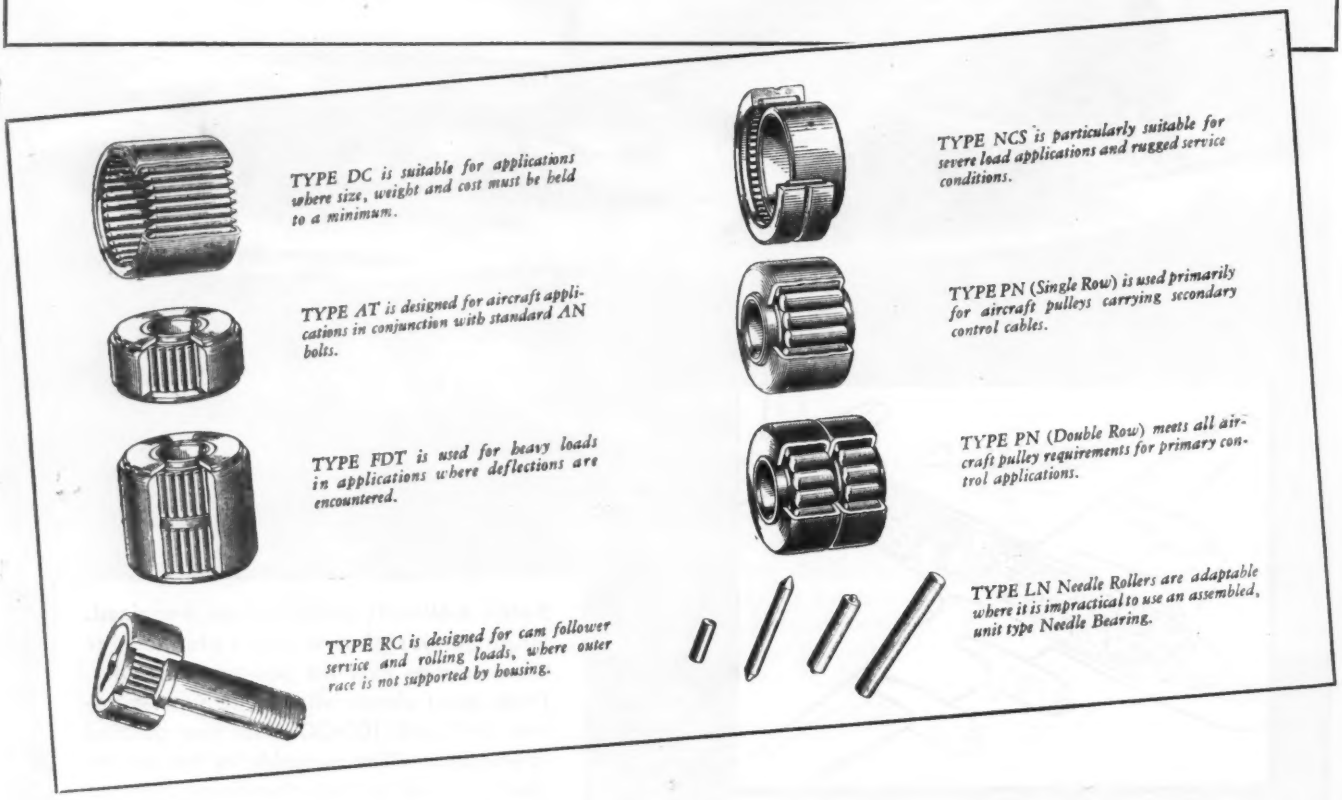
5-MILE-A-MINUTE SPEED in huge 4-engined, 50-passenger planes! That's planned for transportation over the post-war air routes. These great planes will require super-gasoline. SINCLAIR 100-OCTANE, now devoted to war uses, will be available for the new sky giants . . . and for the further development of civilian aviation.

SAFE FROM THE JUNK YARD—but neglect and excessive wear are sending 280 cars there every hour. SINCLAIR-IZE for WINTER service will help your car to last till a new one is available. See your Sinclair Dealer today.

AMERICAN AIRLINES Flagships at an air terminal. They use Sinclair Pennsylvania Motor Oil. American has contracted for huge new Douglas 4-engined planes for passenger service.

Advertisement

One of these Needle Bearings May Solve a Design Problem for You...


TYPE DC is suitable for applications where size, weight and cost must be held to a minimum.
TYPE AT is designed for aircraft applications in conjunction with standard AN bolts.
TYPE FDT is used for heavy loads in applications where deflections are encountered.
TYPE RC is designed for cam follower service and rolling loads, where outer race is not supported by housing.
TYPE NCS is particularly suitable for severe load applications and rugged service conditions.
TYPE PN (Single Row) is used primarily for aircraft pulleys carrying secondary control cables.
TYPE PN (Double Row) meets all aircraft pulley requirements for primary control applications.
TYPE LN Needle Rollers are adaptable where it is impractical to use an assembled, unit type Needle Bearing.

It may not have occured to you that there are so many *different* types of Needle Bearings—or that the completeness of the line of these modern, antifriction bearings makes them adaptable to many design requirements.

Pictured above are eight different types—all different in design yet employing the same basic design principle of a full complement of small diameter needle rollers. Each is engineered for a particular task—or combination of design requirements. Individually each offers the same characteristic advantages of compact design, small size, light weight, high capacity, efficient lubrication and low cost.

The result is that in almost any application where Torrington Needle Bearings are employed, the design problem is simplified; operating efficiency and service life are increased; manufacturing costs are reduced, and sales features are added.

Investigate for yourself how these advantages can be of assistance in your product planning. The Torrington Needle Bearing Catalog 30-A gives complete information, and our engineering staff is ready to help you with any specific design requirement.

THE TORRINGTON COMPANY

Established 1866 • Torrington, Conn. • South Bend 21, Ind.

"Makers of Needle Bearings and Needle Bearing Rollers"

New York Boston Philadelphia
Detroit Cleveland Seattle
San Francisco Chicago Los Angeles
Toronto London, England

TORRINGTON

NEEDLE BEARINGS

"Captain Dag"

trace THIS FIGHTER'S RECORD BY HIS MEDALS!

If there were decorations for industrial heroes, Mr. Dag would be a much be-ribboned gentleman. Perhaps we should call him 'Captain' Dag, because he commands so versatile a company of physical and chemical properties.

Captain Dag (a campaigner who will never be mustered out) represents Dag brand colloidal graphite, the smooth, black liquid concentrate which serves so many different war industries. Capt. Dag may take the form of a dry film, a fluid film, a surface coating, an impregnation, etc.

PHYSICAL AND CHEMICAL PROPERTIES

1. Slippery—A Good Lubricant. Softer than Talc
2. Conducts Electricity
3. Withstands Temperature Extremes
4. Absorbs, Radiates and Conducts Heat
5. Maximum Purity
6. Low Coefficient of Expansion
7. Particles Bear Like Electric Charges
8. Insoluble in Acids and Alkalies
9. Black and Opaque
10. Gas Adsorbent
11. Little Photoelectric Effect
12. Miscible with Most Fluids
13. Films Adhere Tenaciously and Dry with Sharp Edges
14. Microscopically Fine Particles. Penetrates Fine Pores
15. An Excellent Suspension

1, 3, 8, 14, 13, 6

CITATION: "We have been enthusiastic users of Dag colloidal graphite for more than ten years. We find it the only material which will prevent bolts, nuts and flanges from seizing under the high temperature and pressure conditions in our boilers and steam systems."

1, 3, 13, 14

CITATION: "Dry films formed from Dag colloidal graphite supply durable lubrication on parts which could not be effectively lubricated otherwise. Such films are functioning at temperatures from (—60° F. to +1200° F.) and higher."

2, 4, 13, 10, 11, 3

CITATION: "Graphite films when applied to the grids (and frequently the plates) of radio tubes for receiving and transmitting, are useful for minimizing secondary emission, 'back' emission and photoelectric effects."

For easy reference we've given colors to Captain Dag's most valuable properties. Match these colors with the performance "citations" above. Then pin a medal on yourself for putting Captain Dag to work in your plant. He's one campaigner who won't be mustered out.

Dag, Oildag, Aquadag, Castordag, Glydag and Prodag are registered trade marks of Acheson Colloids Corporation. Copr. 1944 by Acheson Colloids Corp.

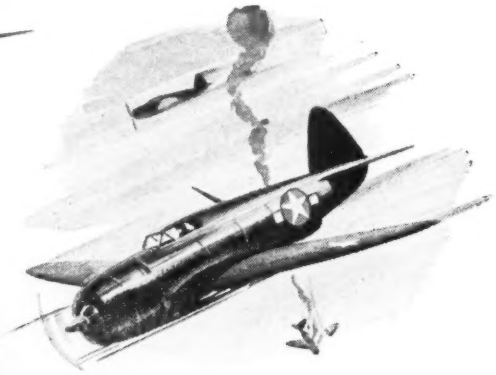
dag COLLOIDAL PRODUCTS

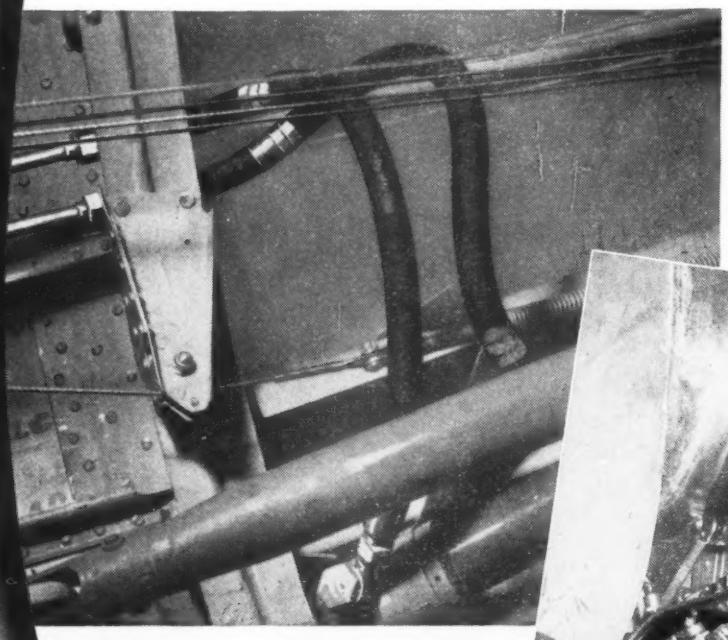
ACHESON COLLOIDS CORPORATION

PORT HURON, MICHIGAN

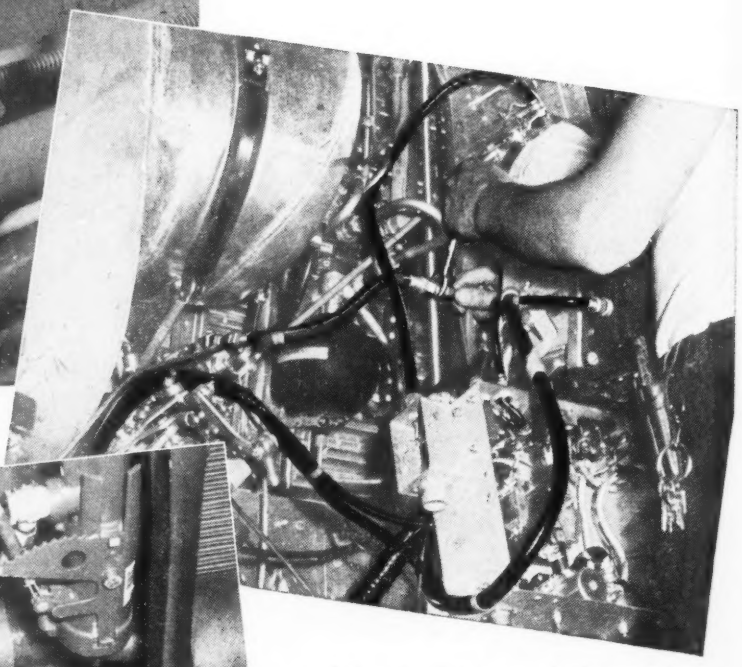
FLEX-O-TUBES ON THE P-47

Flex-O-Tubes are used on fighting aircraft because they have been proven to be reliable. Illustrations by courtesy of the Republic Aviation Corporation.

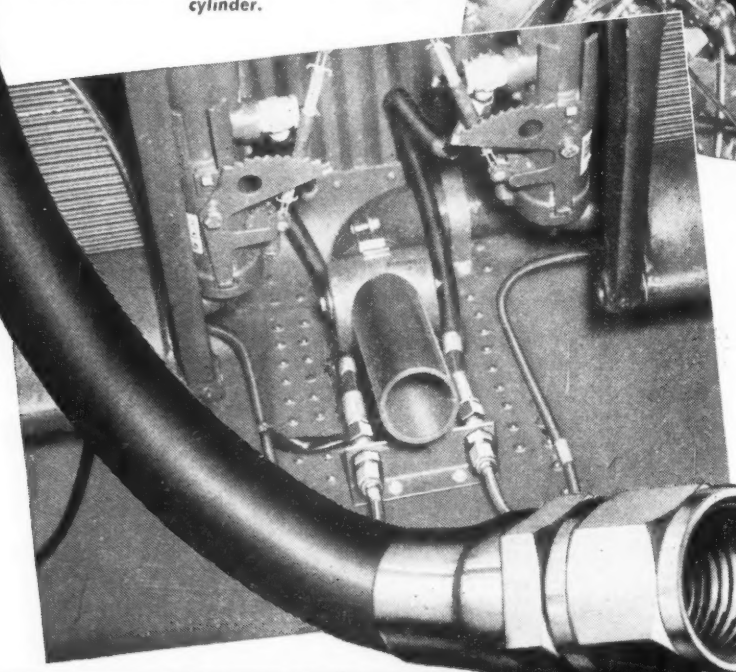




Flex-O-Tubes on the tail wheel actuating cylinder.



Installing Flex-O-Tubes on the front of the fire wall in the accessory section.



Flex-O-Tubes in the brake line to each pedal in the cockpit, one temporarily disconnected.

THE **Flex-O-Tube** COMPANY

LAFAYETTE at 14th AVE.,
DETROIT 16, MICHIGAN
Offices: CHICAGO · FORT WORTH
LOS ANGELES · NEW YORK
SEATTLE · TORONTO, ONT.

Embarrassed by *Surplus Inventory?*

Sudden cancellations can leave you with tons of surplus steel, useless for peacetime operation. Why not eliminate the risk — use *Frasse* inventories instead?

Frasse stocks of cold finished bars, tubing, stainless steel, alloy and aircraft steels are ample. Tonnage has more than doubled to serve war needs. By using Frasse stocks as you go, you keep your own inventory *low* — escape dead surplus when cancellations and cutbacks occur.

No need to pile up your "surplus problem" with Frasse stocks handy. No need to wait, either, for steel when your reconversion starts. Frasse deliveries are *immediate* — can save you weeks, even months, in changing over. To plan quick reconversion, plan on quick steel — from Frasse.

Frasse Mechanical and Aircraft Steels

COLD FINISHED CARBON BARS, SHEETS AND STRIP • SAE, AISI AND NE ALLOY BARS
DRILL ROD • AIRCRAFT ALLOY BARS AND TUBING • STAINLESS STEEL SHEETS, STRIP, PLATES, BARS, WIRE, PIPE AND TUBING • SEAMLESS CARBON AND ALLOY TUBING
SEAMLESS PIPE AND CONDENSER TUBING • WELDED CARBON AND ALLOY TUBING

PETER A. FRASSE & CO., INC. 17 Grand St., New York 13, N. Y. (Walker 5-2200) • 3911 Wissahickon Ave., Philadelphia 29, Pa. (Radcliff 7100 - Park 5541) • P. O. Box 946, Buffalo 5, N. Y. (Washington 2000)
Jersey City 2, N. J. • Hartford 5, Conn. • Rochester 4, N. Y. • Syracuse 2, N. Y. • Baltimore 2, Md.

"Right on the Nose"
SENSENICH
Right on the Nose of the Culver Cadet
Out on Top of the Grumman Widgeon
Right on the Nose of the Stinson L-5
Right on the Nose of the Piper J-3
Right on the Nose of the Ercoupe
Right on the Nose of the Ryan PT-22
Right on the Nose of the Fairchild UC-61K
Right on the Ship of the Future

"RIGHT ON THE NOSE" is more than an advertising phrase. It is a fact. The illustrations above show only a few of the ships on which Sensenich propellers are standard equipment. But they represent the combined efforts of quite a sizable group of the nation's best aircraft engineers, designers, builders and test pilots.

These men—by specifying and approving Sensenich propellers on the nose of their ships—have expressed their joint confidence in Sensenich's know-how as a wood propeller designer and producer.

No other propeller manufacturer has been chosen so often by so many!

NOW AVAILABLE FOR PRIVATE AND COMMERCIAL PLANES

For several years most Sensenich propellers have gone to the armed forces—*but now they are again available* to civilians. Ask your aircraft parts supplier or write direct for a list showing Sensenich model numbers for all planes including government ships now being sold.

REPAIR SERVICE now available for wood propellers of any make, at main plant or West Coast Branch.

SENSENICH BROTHERS, Lancaster, Pa.—adjacent to Lancaster Municipal Airport; West Coast Branch, Glendale, Calif.

AIRCRAFT **Sensenich** PROPELLERS

NAVAL AVIATION

WHEN HELLCATS STRIKE...
CHAMPION
360 JAP PLANES DESTROYED IN ONE DAY
75 JAP PLANES DESTROYED IN ONE DAY
ONE SQUADRON 187 JAP PLANES NO LOSSES
1ST 5 MONTHS 1944 767 JAP PLANES DESTROYED 444 IN COMBAT 323 ON GROUND

..CHAMPION SPARK PLUGS

INSURE DEPENDABLE IGNITION!

The Navy's great fighter, the Hellcat built by Grumman, is setting almost daily, unparalleled records in combat. The combination of Navy pilots' skill, courage and daring, and the obviously great ships that they fly, is a winning one. "Hot" pilots and "hot" engines go together. Champion Spark Plugs and "hot" engines likewise go together, and championship performance is always the result. So today they are firmly established as true champions in the air, as they are on land and water. Champion-Ceramic Aircraft Spark Plugs are standard equipment in the Pratt & Whitney engine which powers the Grumman Hellcat. Thus Champions continue to demonstrate their better performance and outstanding dependability in service where spark plug dependability may spell the difference between being victor or vanquished. Champion Spark Plug Company, Toledo 1, Ohio.

C26—Unshielded

INSTALL CHAMPIONS AND FLY WITH CONFIDENCE

UNIONAIR RESPONSIBILITY
HAS MADE THIS REQUISITION TODAY'S REALITY

Unionair has made important contributions, during the war effort, to the design and production of electrical assemblies for United States Naval Aircraft and the Aircraft Industry.

We intend to continue in the post war aviation world.

Our first contribution is a complete basic electrical system available to all light plane manufacturers.

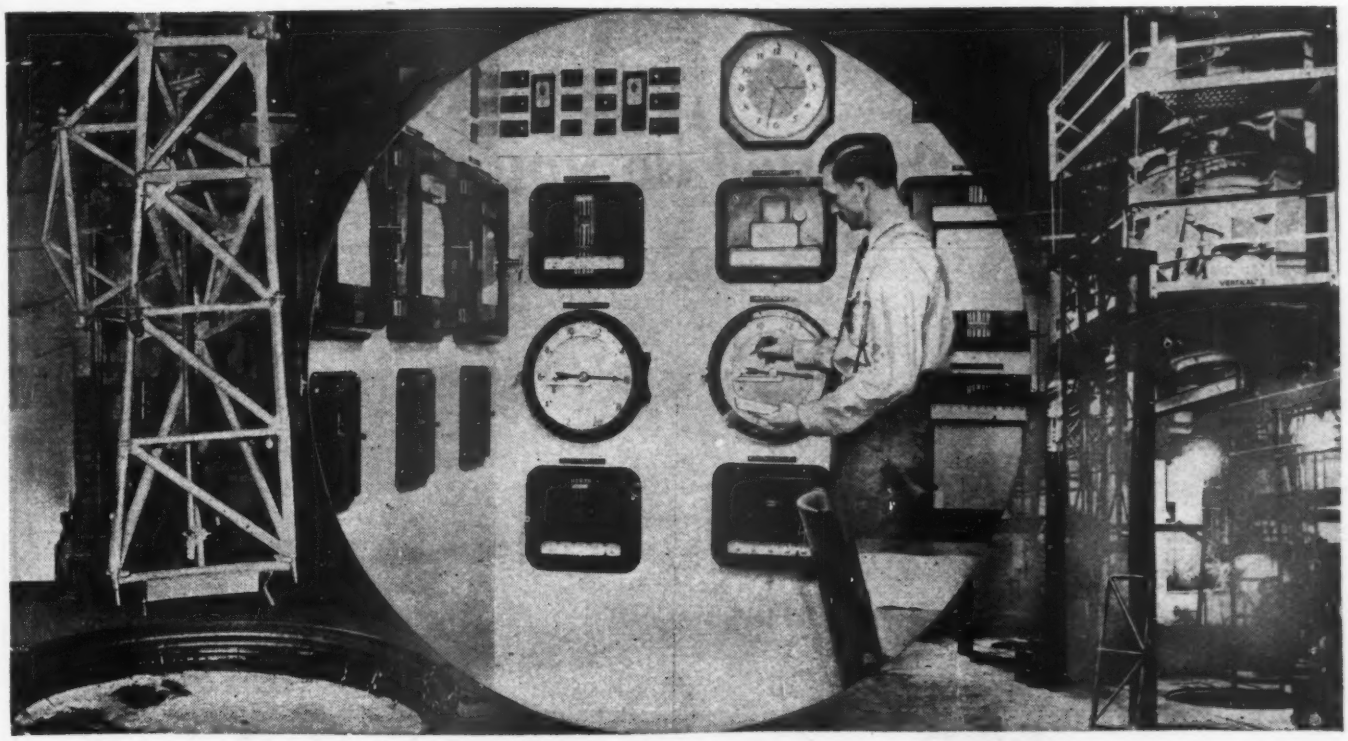
ARMY E NAVY

UNIONAIR

WRITE FOR NEW BOOKLET "ELECTRICAL ASSEMBLIES MADE TO CUSTOMERS' SPECIFICATIONS"

Electrical Assemblies — Hydraulic Fittings — Conduit Fittings — Junction Boxes

UNION AIRCRAFT PRODUCTS CORP., NEW YORK



Jigged to prevent distortion, this welded member for the nacelle of a Beechcraft plane plunges from its Micromax-controlled vertical furnace into oil-quench. Quenching is complete in 5 to 8 seconds.

Beech Aircraft's centralized control room in which are located the Micromax Pyrometers to regulate all heat-treating temperatures. The foreman is consulting the Pyrometer for the vertical nacelle-furnaces.

One of the Micromax-regulated furnaces in which nacelle elements are heated. These furnaces are gas-fired, full muffle, atmosphere-controlled; are specially designed to Beech's needs.

BEECH INCREASES HEAT-TREAT EFFICIENCY
By Centralizing Its Micromax Controllers

Heat-treating operations performed in the Beech Aircraft Corp. plant at Wichita, Kansas, include case hardening, annealing, normalizing, stress-relieving, hardening, etc. The job of automatically controlling the temperatures of these operations has been turned over to Micromax Pyrometers, with the result that their micro-responsive control is giving Beech routinely dependable heat-treatment.

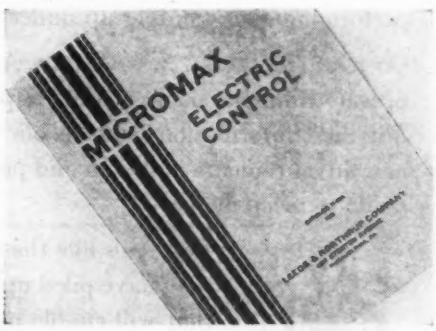
For utmost efficiency, instruments are centralized in a specially-designed control room. Here all Micromax Controllers have the same ambient temperatures; all operating conditions are standardized; one man keeps all temperatures under his eye. The room is supplied with air at a slight positive pressure so that dust and fumes cannot enter—a valuable time-saver when pyrometers, hardness testers and other instruments are to be kept at optimum accuracy and dependability.

Instrumentation of Vertical Furnaces

Typical of the special equipment employed is that for airplane nacelles. These are hardened in vertical furnaces, set well up in the air and directly above the quench tanks. The furnaces are muffle units, gas fired and supplied with specially prepared atmosphere to prevent oxidation or other change of the plane parts. Nacelles are quenched through doors in the furnace bottoms.

These furnaces have three firing zones, each with its Micromax Controller. In the round picture above, one group of three Controllers can be seen directly below the clock; the top and bottom instruments, on the first and third zones, are Indicating Controllers, while the middle zone has the Recording Controller which the foreman is examining.

These instruments bring micro-responsiveness to temperature regulation, so that almost simultaneously with the appearance of heat lags or surges, the fuel valves are adjusted to bring temperature back to the control point. Equipments incorporate the outstanding features of Micromax design: sturdy machine-type parts; extra-heavy gears, shafts and bearings; fine construction throughout.



Further information will be sent on request; either a general catalog or specific engineering data, as you prefer.

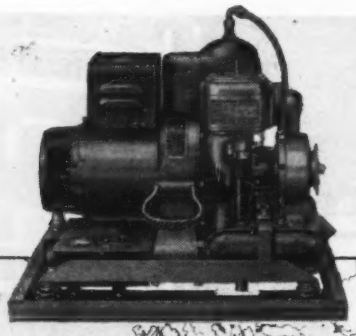
A Slogan For Every American

Jrl Ad N-33-620(9)

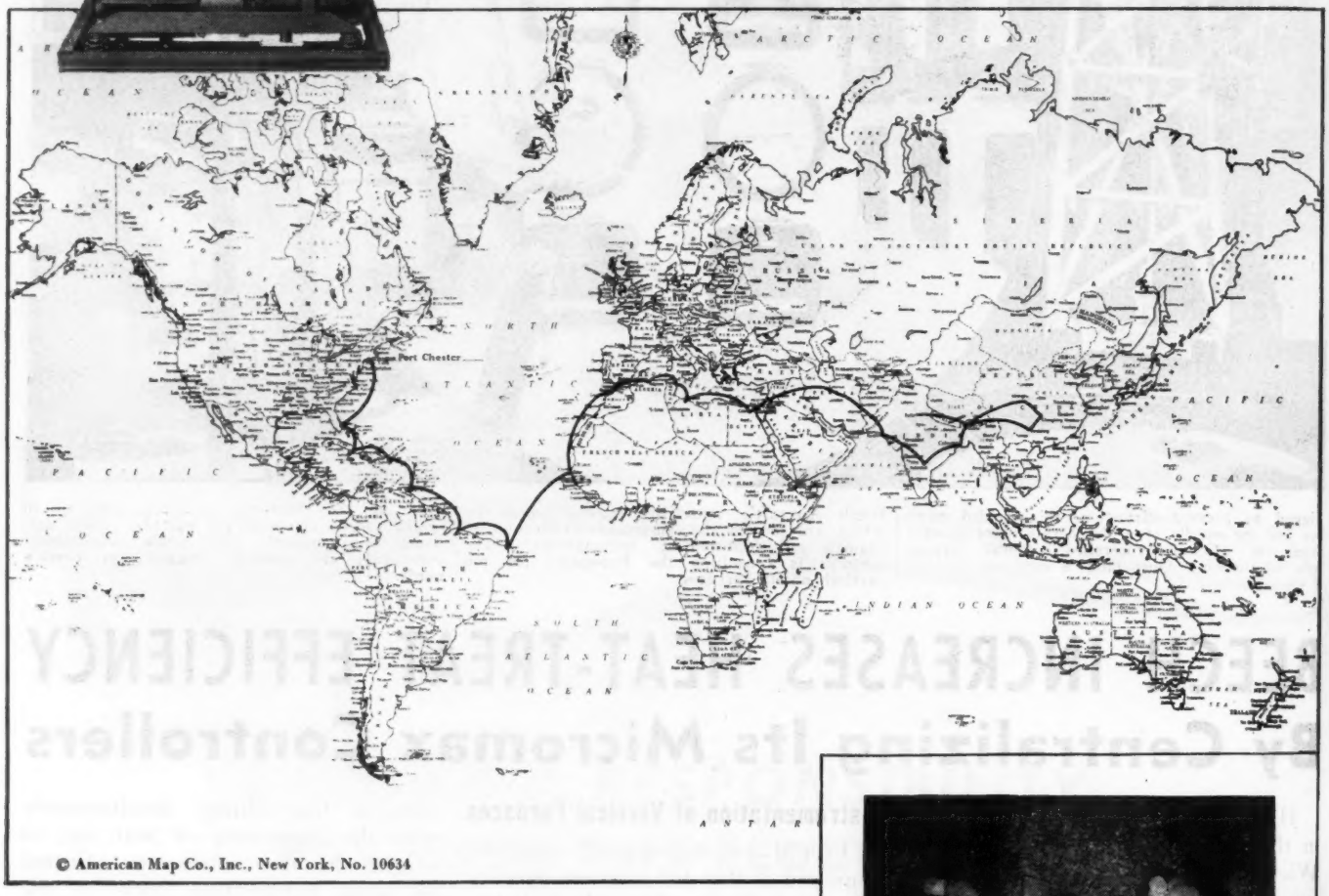
LEEDS & NORTHRUP COMPANY, 4906 STENTON AVE., PHILA. 44, PA.

LEEDS & NORTHRUP

MEASURING INSTRUMENTS · TELEMETERS · AUTOMATIC CONTROLS · HEAT-TREATING FURNACES



HERE'S A TRIP
that will do you a Lot of Good



© American Map Co., Inc., New York, No. 10634

From Port Chester, New York, to Chungking, China . . . with plenty of stops in between.

Just one trip of many . . . made by a Homelite service man . . . to get facts . . . to find out how Homelite Portable Generators are performing and standing up under the tough conditions of war.

On trips like these . . . to Alaska, Africa, India and all the theatres of war, Homelite men get the "dope" first hand. And they transmit their information back to our engineering department where new advancements in design and performance are constantly being made to meet the pace.

Yes, trips like these will do you a lot of good. For they have piled up a wealth of priceless experience that will enable us to give you better generators, better pumps and better blowers, than you ever had before.

THE BENEFITS FOR YOU

Better cold weather operation . . . better hot weather operation . . . new cooling methods . . . advanced type bearings . . . less trouble and maintenance . . . much longer wear . . . more power . . . more portability . . . these and many other features will be but standard advantages of the New Homelite Gasoline-engine-driven Generators, Pumps and Blowers that you will get and use, after the war is over.

HOMELITE CORPORATION
PORT CHESTER, NEW YORK

PORTABLE PUMPS • GENERATORS • BLOWERS

Photo-Courtesy Fairchild Aircraft

RIDING ON AIR DEMANDS THE STRENGTH AND LIGHTNESS OF A *Steel Tube* FRAME

"Tubes of Air Surrounded by Steel"
have no superior for the airplane framework. The welder makes fast work of assembly and welding on fittings.

Seamless steel tube struts make a fuselage frame for this Fairchild Trainer that combines strength with lightness. Globe Seamless Steel Tubes are made in a plant devoted exclusively to the manufacture of steel tubing . . . where every process from piercing the billet to finish grinding is closely controlled.

An exacting inspection is given every finished tube. Even the chance of a stray tube of different analysis getting into a shipment is eliminated by passing all tubes through the Identometer test.

5011

GLOBE TUBES

★ Boiler and Pressure Tubes
★ Condenser and Heat Exchanger Tubes
★ Stainless Tubes (Seamless)
★ Mechanical Tubing
★ Gloweld Tubes (Welded Stainless)
★ Globeiron Tubes (Seamless Pure Iron)

GLOBE STEEL *Tubes*

GLOBE STEEL TUBES CO. *Milwaukee 4, Wisconsin, U. S. A.*

"PITTSBURGH" DEVELOPMENTS IN AIRPLANE GLASS

"Low Wedge Angle" Bullet-Resisting Glass

THE PROBLEM: To give pilots greater clarity and range of vision, especially in night-fighters, by eliminating gunsight reflector glass.

THE SOLUTION: Development by Pittsburgh Plate Glass Company of a bullet-resisting glass of extreme flatness and parallelism of surfaces. This glass serves the triple function of a windshield, armor plate, and a gunsight reflector glass. This "low wedge angle" glass, in addition to removing the necessity for a separate reflector glass, permits the gunsight to be mounted in a different location, thus decreasing the crash hazard inherent in the older type of reflector glass. *(See sketch.)*

The development of this special bullet-resisting glass, accomplishing an improvement formerly thought impossible, is typical of the contributions to airplane glazing made by Pittsburgh Plate Glass Company. Such developments have given this company recognized leadership in the field of airplane glass and glazing. If you would like further technical data on any aspect of safety glass for airplanes, write us on your business letterhead. Address Pittsburgh Plate Glass Company, 2336-4 Grant Building, Pittsburgh 19, Pennsylvania.

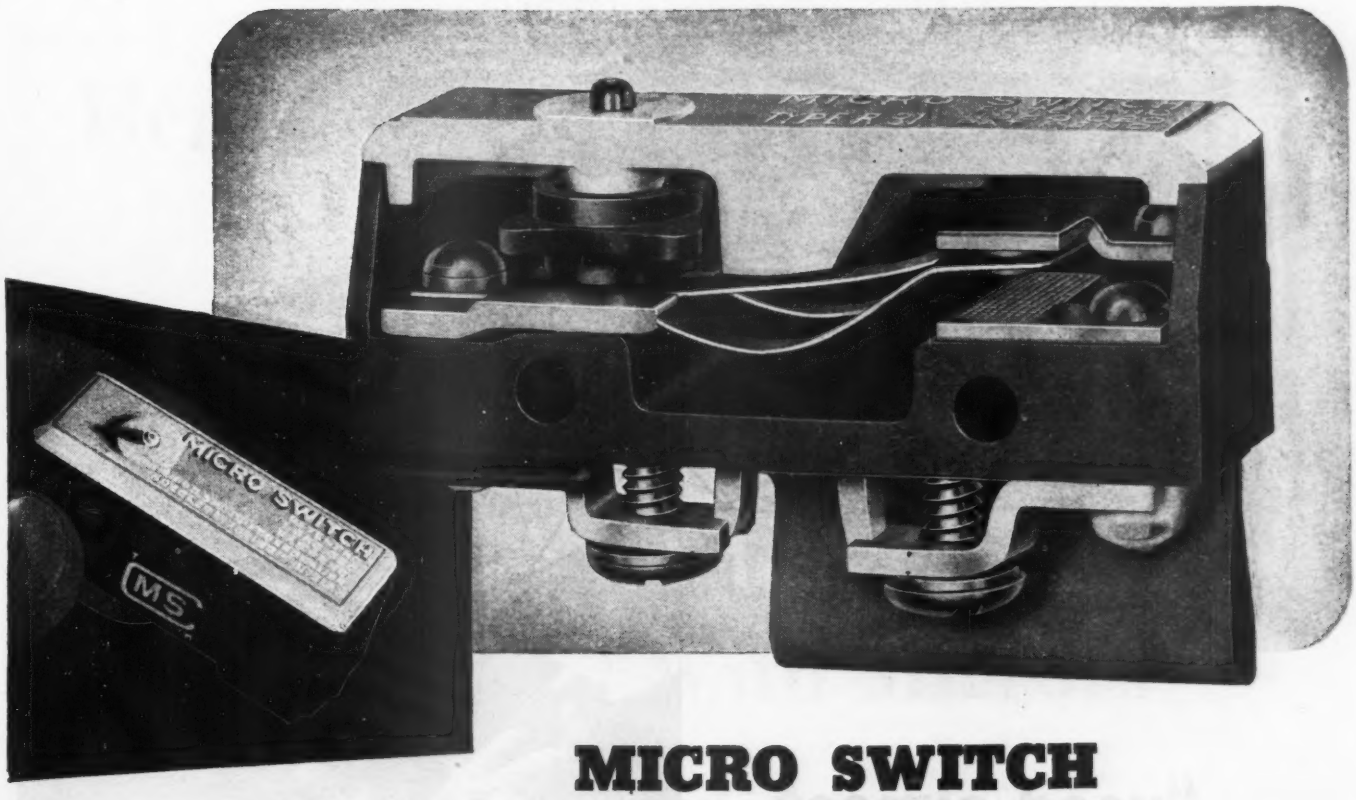
"PITTSBURGH" stands for Quality Glass and Paint

PPG

PITTSBURGH PLATE GLASS COMPANY

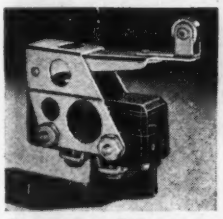
Specialists in Airplane Glass

MAKERS OF DUPLATE AND FLEXSEAL SAFETY GLASS AND OF-MULTIPLATE BULLET-RESISTING GLASS

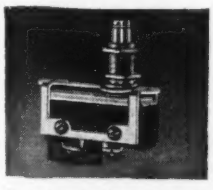


MICRO SWITCH

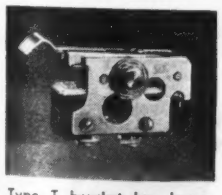
Most widely used precision snap-action switch in the world



The new Type "A" actuator is of cold rolled steel with cadmium plate finish. Movement differential is .031" maximum; operating pressure is approximately 6 ounces; pre-travel is approximately 1/8"; overtravel is approximately 1/2".



Type M series of panel mounting brackets offer two lengths of threaded stems for easy positioning. Operation takes place in first 1/32" of plunger travel. Overtravel of 1/4" or 3/8" is provided.



Type T bracket has been widely used as throttle warning switch singly or in gangs. Operated by cams on throttle quadrant or dogs on cables. A sturdy mount and actuator for general use as a limit switch.

Especially designed for aircraft, the Type R-31 Micro Switch has been successfully used on millions of aircraft installations which include all types of fighters, bombers, transports, commercial and private planes.

The cut open switch illustrates the basic Type R-31 Micro Switch. The *three blade beryllium copper spring* is the patented heart of the Micro Switch. Carefully heat treated, its *one piece construction* insures extremely long life . . . eliminates lost motion and friction between loosely coupled elements. *Spring dimensions* are accurately held to insure uniformity through millions of accurate repeat operations. *Contacts* move in the same direction as operating plunger so that its direct force is available to break contact welds which might result from accidental overload.

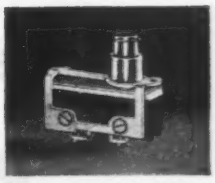
Outside leaves of the beryllium copper spring pivot in grooves of patented shape in a solid brass anchor. *Operating plunger* is a highly polished, hard, stainless steel pin insuring long, trouble-free, accurate performance.

Deep, box type construction of the *molded Bakelite* case gives the rigidity necessary for accurate repeat performance over wide ranges of temperature and operating conditions. *Covers* are permanently secured to housings to prevent tampering with accurate adjustment of elements.

All basic Micro Switches are rated by Underwriters' Laboratories and Canadian Engineering Standards Association as follows: 10 amperes, 125 volts A.C.; 5 amperes, 250 volts A.C.; 3 amperes, 460 volts A.C.

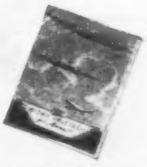
Contact separation spacing shown is .070". This relatively wide gap, pioneered by Micro Switch Corporation, has proven successful in switching highly inductive D.C. loads up to 45,000 feet altitude. For A.C. uses, contact separations of .010" to .020" are used successfully. Terminals shown are of the heavy duty screw type, standard on aircraft.

A few of the *actuator brackets* designed to accommodate the Type R-31 Aircraft Micro Switch are shown on this page. Their use permits fast and easy installation and makes for easy field replacement without disturbing bracket.



Type MS2731A skeleton bracket has definitely controlled pretravel and overtravel—a total of 1/4". Meets Air Corps specifications for Types A-1 and A-2 switches.

Type H series of aluminum housings, one illustrated, are complete with plunger actuator. Can be sealed against splash, dirt or oil. "A-N" outlet fittings may be straight or adjustable to 45 degrees.



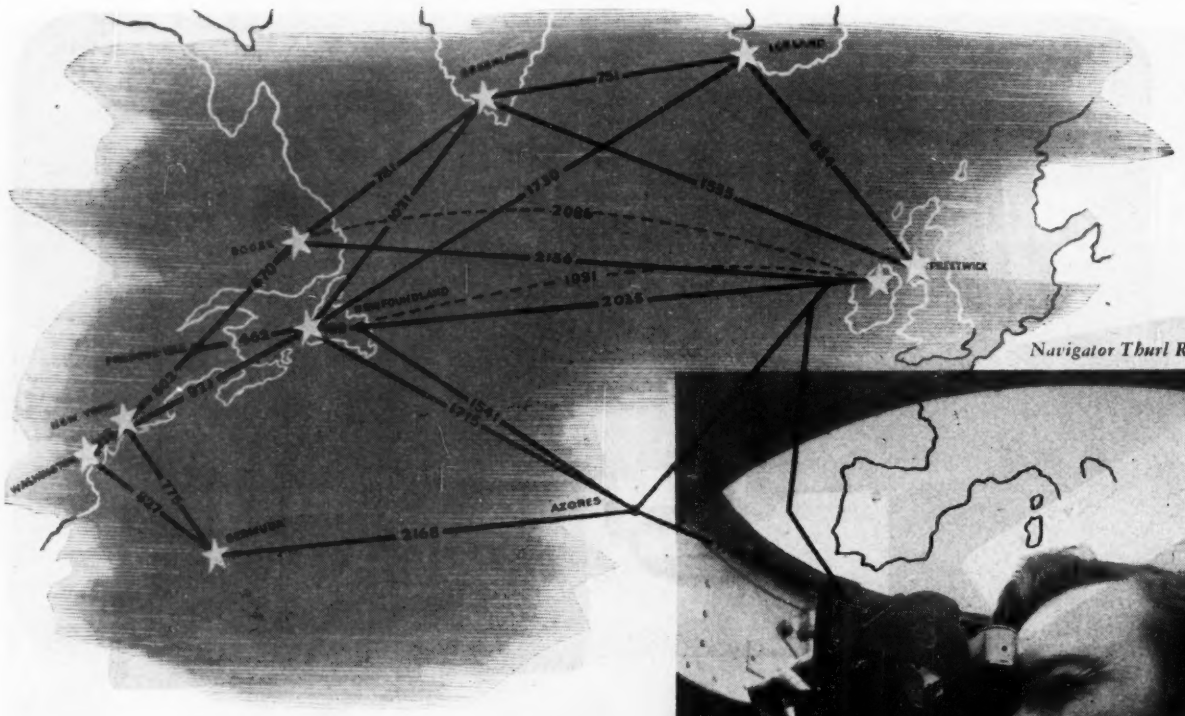
For complete details of the Type R-31 Micro Switch, send for Aircraft Catalog No. 71.

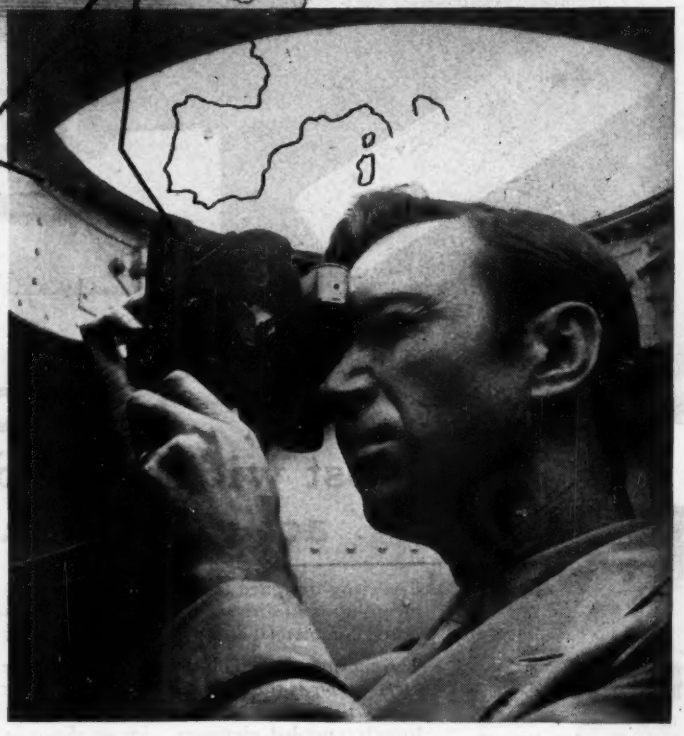
MICRO MS SWITCH
MARK
TRADE

A DIVISION OF FIRST INDUSTRIAL CORPORATION

FREEPORT, ILL., U.S.A., Sales Offices in New York, Chicago, Cleveland, Los Angeles, Boston, Dallas, Portland, (Ore.)

© 1944





Navigator Thurl Ravenscroft of TWA

"used almost exclusively by TWA The TRANSCONTINENTAL Airline on all transoceanic flights"

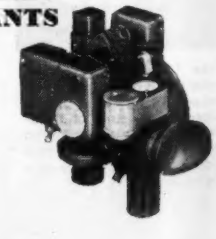
Ask any navigator, whose calculations have controlled the fate of trackless transoceanic flights, how he feels about aerial sextants. Invariably he'll answer that a sextant is more than an instrument of precise measurement. It's something you trust — or don't. It has to do with air-instinct. Something known only to men who know the skies.

Ed Bolton, chief navigator of the far flung routes of the TWA Intercontinental Division says, "Our navigators use Fairchild Aerial Sextants almost exclusively on all transoceanic flights. They are dependable, rugged, compact, accurate."

And rightfully so. For Fairchild Aerial Sextants were developed from a basic design suggested by the U. S. Army Air Force to be compact, lightweight, easily handled .... with a bubble that remains 'stable' . . . with automatic recording of consecutive sights during the entire sighting cycle of optional duration.

Fairchild leadership in the design and precision production of aerial operations instruments . . . which include aerial sextants, cameras, radio direction finders, lead computing gun sights . . . is the reward of an air-minded policy of engineering and building far beyond the stated basic specifications of any given problem. *New York Office:* 475—10th Avenue, New York 18; *Plant:* 88-06 Van Wyck Boulevard, Jamaica 1, New York.

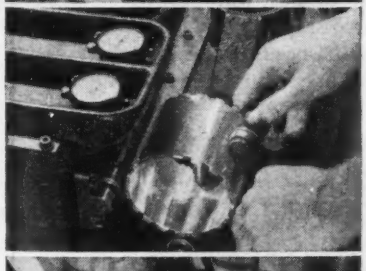
AERIAL SEXTANTS



Fairchild CAMERA AND INSTRUMENT CORPORATION

Here's a Picture

That's Not Made With Mirrors



LIKE Tweedledum and Tweedledee, these Mallory Bearings look so much alike that they might be photographic copies of each other—eight reflections of a single bearing. As a matter of fact, they ARE alike; so much so that, even under precision tests, they show less than one-tenth of one thousandth of an inch variation.

It's a vital matter that these bearings—in appearance as well as fact—are uniform. They're used in the fastest military planes today: planes where tolerances are measured in split-thousandths, where uniformity and dependability are critical essentials.

Mallory Bearings, made by the Mallosil Process, measure up to these standards, which is why so many manufacturers have adopted Mallory Bearings for exacting uses. By bonding silver to base metal backings, the Mallosil Process permits large scale production of precision aviation bearings that meet the most brutal stresses and strains that fighter and bomber engines must undergo. Thanks to the control given by the Mallosil Process —and to rigorous inspection methods (some of which are illustrated)— Mallory Bearings attain practically one hundred percent uniformity.

Mallory Bearings give rich promise for the future: in commercial aviation, trucks, buses, machine tools, Diesel-powered engines and elsewhere. War production occupies our stage today. But we are looking ahead to tomorrow —and will be glad to discuss bearing problems and applications for peacetime designs.

**Reg. U. S. Pat. Off.*

P. R. MALLORY & CO., Inc., INDIANAPOLIS 6, INDIANA

ARMY E NAVY

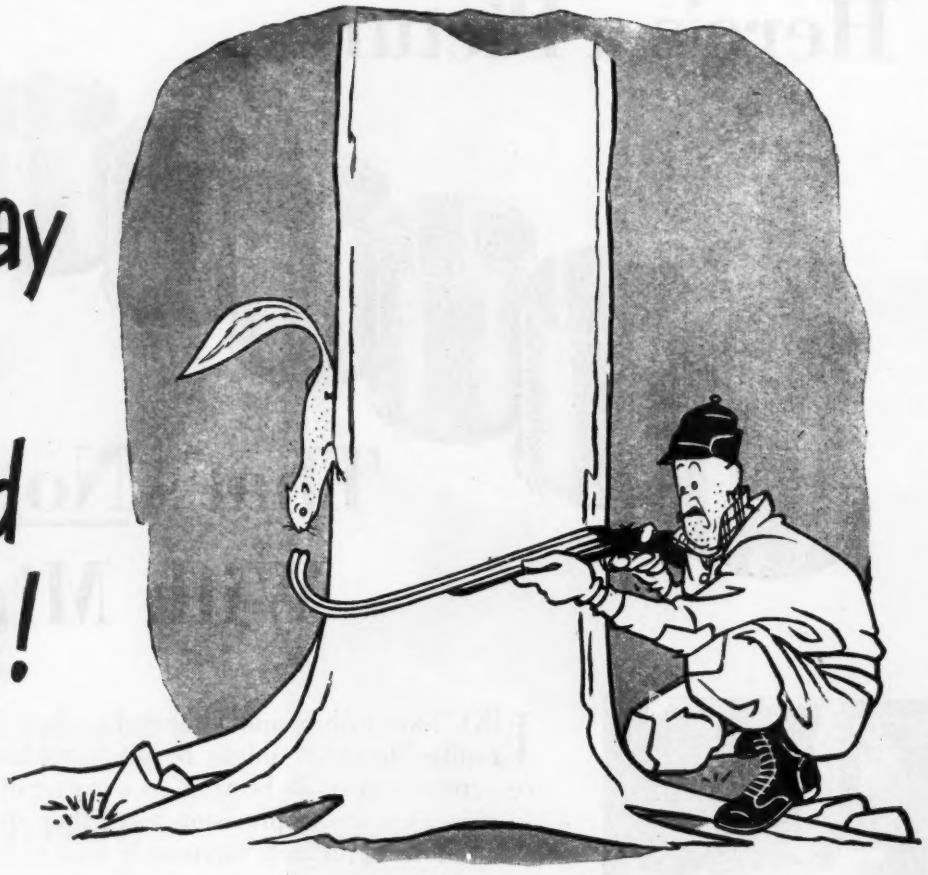
Invest in America—Buy War Bonds

P.R. MALLORY & CO. Inc

MALLORY

SERVES THE AVIATION, THE AVIATION-INSTRUMENT AND THE AVIATION-COMMUNICATION FIELD WITH WELDING TIPS, THE MALLOSIL* PROCESS—BEARINGS, SPECIAL ALLOYS, ELECTRICAL CONTACTS, VIBRATORS, VIBRAPACKS,* CONDENSERS, ROTARY AND PUSH BUTTON SWITCHES, ELECTRONIC EQUIPMENT, COMMUNICATIONS HARDWARE, RECTOSTARTERS*

New way to get around curves!



Revolutionary new design enables Crown Zippers to slide freely around sharp curves—slide faster, smoother!

Today, Crown engineers, working in the field with Air Corps, Ordnance and Quartermaster officers, have developed a zipper that is making history—a zipper that actually slides freely around sharp curves.

Tomorrow, when the last shot has been fired, this great new zipper feature will find many applications in the aviation field—for engine covers, built-in inspection slits that can be zipped open, baggage compartment openings—and for many other vital jobs.

But a Crown Zipper's ability to take curves is only one of many basic advantages it has over ordinary, old-style zippers. (See complete list below.)

That is why Crown Zippers are in action today throughout the world — on airplane gun turrets, armored trucks, tents, sleeping bags and many other military items where human life depends on instant, unfailing action.

Remember, when you turn to post-war: Crown designers will adapt—or, if necessary, *create*—special zipper applications to meet special needs. Remember: you can zip faster, further, more securely, with a Crown Zipper!

CROWN ZIPPERS are 5 ways better

1. Takes sharp curves

2. Die-cast for smoother action—extra strength

3. Provides opening wherever you want it

4. Won't lock open

5. Resists corrosion

Member of the J. & P. Coats • Clark's ONT *Family*

THE SPOOL COTTON COMPANY • *745 Fifth Avenue, New York, N. Y. (Crown Fastener Division)*

The Most Extensive Line of Compression Riveters

IDEAL FOR DIMPLING

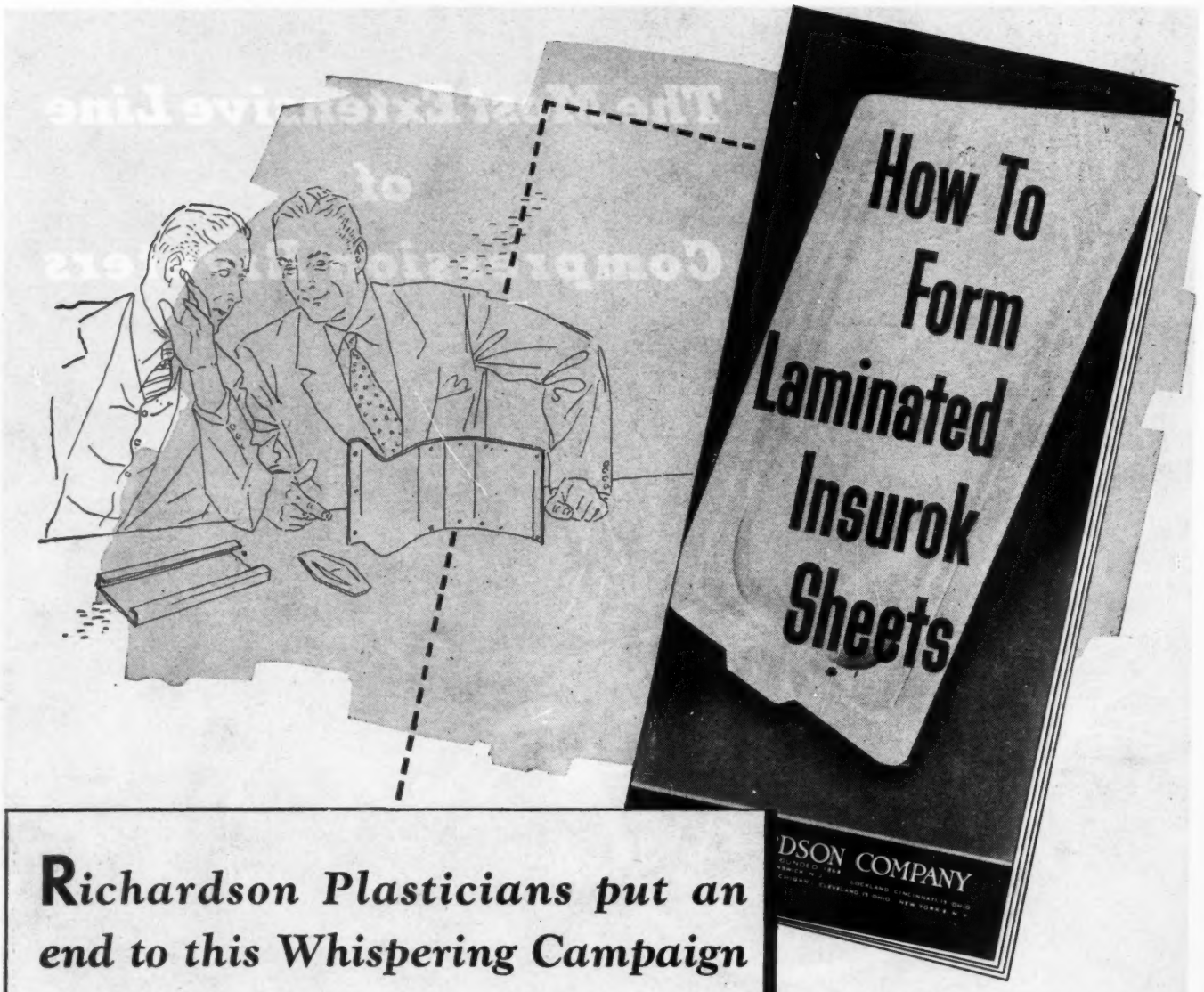
CP offers the most extensive line of compression riveters – double purpose tools which are ideal for dimpling as well as riveting. They drive tight rivets with a single stroke and form a head of proper height. CP Compression Riveters – Dimplers are available with yokes of various shapes, sizes, reaches and gaps to meet individual requirements.

Chicago Pneumatic portable, semi-portable and stationary Compression Riveters cover a rivet range of 1/8" in Dural, aluminum, iron and steel to 1/4" in Dural, iron and steel and 5/16" in aluminum. For complete information, write for Catalog No. 564.

★★★★★★★★★
PNEUMATIC TOOLS
ELECTRIC TOOLS
HYDRAULIC TOOLS
ROCK DRILLS

CHICAGO PNEUMATIC
TOOL COMPANY
General Offices: 8 East 44th Street, New York 17, N. Y.

★★★★★★★★★
AIR COMPRESSORS
VACUUM PUMPS
DIESEL ENGINES
AVIATION ACCESSORIES



Richardson Plasticians put an end to this Whispering Campaign

They've taken the mystery out of forming Laminated INSUROK plastic sheets! For actually it is a simple process . . . one you can do yourself if you *know how.* And here is a small booklet that puts you in the know . . . the A B C's of how to form laminated plastic sheets yourself.

It is as easy as this:

A. HEAT the laminated sheet uniformly slightly below the blistering point.
B. INSERT the heated sheet in the forming fixture and apply pressure.
C. ALLOW part to cool and then remove.

Result . . . the shape is now permanent.

Laminated INSUROK plastic sheets for forming have varied uses. They combine strength with lightness . . . are resistant to sudden changes in temperature . . . withstand the destructive actions of most chemicals, reagents, and solvents.

Write today for the booklet that tells all about forming laminated plastic sheets . . . "*HOW TO FORM LAMINATED INSUROK SHEETS.*" It's FREE for the asking. Send for it on your company letterhead.

You may prefer to have the forming done for you. If so, the working knowledge and years of practical experience of Richardson Plasticians are at your disposal.

INSUROK *Precision Plastics*

The RICHARDSON COMPANY

MELROSE PARK, ILL. NEW BRUNSWICK, N. J. FOUNDED 1868 INDIANAPOLIS 1, IND. LOCKLAND, CINCINNATI 15, OHIO
DETROIT OFFICE 6-252 G. M. BUILDING, DETROIT 2, MICHIGAN NEW YORK OFFICE 75 WEST STREET, NEW YORK 6, N. Y.
CLEVELAND OFFICE 326-7 PLYMOUTH BLDG., CLEVELAND 15, OHIO

NEW OHMITE ARMY-NAVY AIRCRAFT RHEOSTATS

with New Improved, Control Protection

FOR LATEST AN-R-14a (Drawing AN3155) SPECIFICATIONS

Smooth, Close, Dependable Control Under Every Service Condition of

HEAT
COLD
HUMIDITY
ALTITUDE
SHOCK
VIBRATION

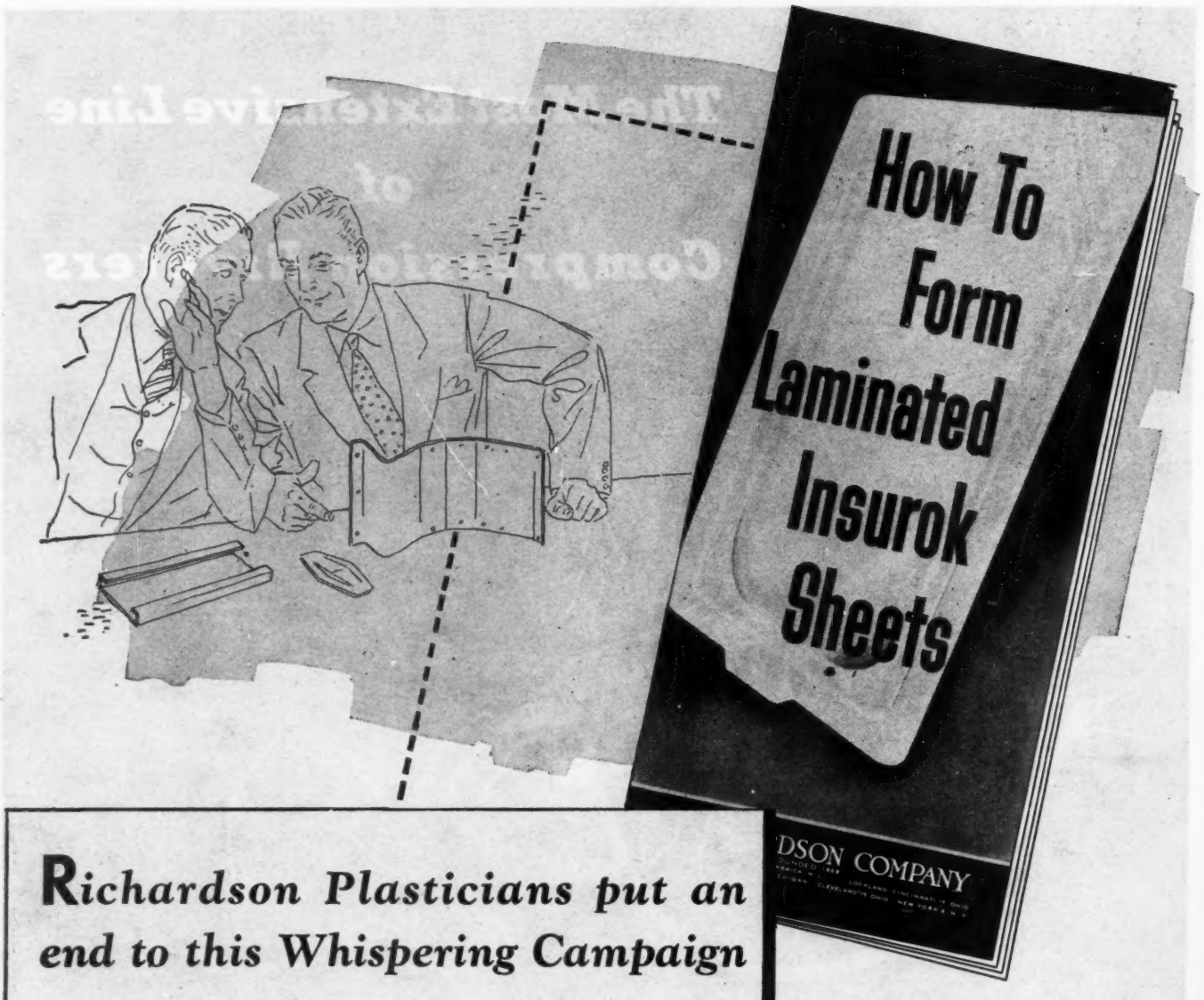
These new Ohmite AN Rheostats are light in weight—much lighter than the allowable weight specified. Meet salt spray corrosion test. Operate satisfactorily in the temperature range from −55°C (−67°F) to +70°C (+158°F).

Here are the new approved Ohmite Power Rheostats for aircraft, made in accordance with the latest Army-Navy Aeronautical Specifications. These units have the advantage of many time-proved Ohmite rheostat features *plus* new, improved control protection. They are rugged in design and construction to provide uniform electrical and mechanical control . . . and assure utmost dependability . . . under all operating conditions.

Two sizes: Model "J" 50-watt and Model "H" 25-watt. Linear or Taper wire-wound, in various resistances, with "off" position, as required. Totally enclosed in a compact, corrosion-resisting metal container. Complete with knob as shown. Write, wire or phone for further information.

OHMITE MANUFACTURING CO.
4946 FLOURNOY ST., CHICAGO 44, U. S. A.

Be Right with OHMITE
RHEOSTATS • RESISTORS • TAP SWITCHES



Richardson Plasticians put an end to this Whispering Campaign

They've taken the mystery out of forming Laminated INSUROK plastic sheets! For actually it is a simple process . . . one you can do yourself if you *know how.* And here is a small booklet that puts you in the know . . . the A B C's of how to form laminated plastic sheets yourself.

It is as easy as this:

A. HEAT the laminated sheet uniformly slightly below the blistering point.
B. INSERT the heated sheet in the forming fixture and apply pressure.
C. ALLOW part to cool and then remove.

Result . . . the shape is now permanent.

Laminated INSUROK plastic sheets for forming have varied uses. They combine strength with lightness . . . are resistant to sudden changes in temperature . . . withstand the destructive actions of most chemicals, reagents, and solvents.

Write today for the booklet that tells all about forming laminated plastic sheets . . . "*HOW TO FORM LAMINATED INSUROK SHEETS.*" It's FREE for the asking. Send for it on your company letterhead.

You may prefer to have the forming done for you. If so, the working knowledge and years of practical experience of Richardson Plasticians are at your disposal.

INSUROK *Precision Plastics*

The RICHARDSON COMPANY

MELROSE PARK, ILL. NEW BRUNSWICK, N. J. FOUNDED 1868 INDIANAPOLIS 1, IND. LOCKLAND, CINCINNATI 15, OHIO
DETROIT OFFICE: 6-252 G. M. BUILDING, DETROIT 2, MICHIGAN NEW YORK OFFICE 75 WEST STREET, NEW YORK 6, N. Y.
CLEVELAND OFFICE 326-7 PLYMOUTH BLDG., CLEVELAND 15, OHIO

NEW OHMITE ARMY-NAVY AIRCRAFT RHEOSTATS

with New Improved, Control Protection

FOR LATEST AN-R-14a (Drawing AN3155) SPECIFICATIONS

Smooth, Close, Dependable Control Under Every Service Condition of

HEAT COLD HUMIDITY ALTITUDE SHOCK VIBRATION

These new Ohmite AN Rheostats are light in weight—much lighter than the allowable weight specified. Meet salt spray corrosion test. Operate satisfactorily in the temperature range from −55°C (−67°F) to +70°C (+158°F).

Here are the new approved Ohmite Power Rheostats for aircraft, made in accordance with the latest Army-Navy Aeronautical Specifications. These units have the advantage of many time-proved Ohmite rheostat features *plus* new, improved control protection. They are rugged in design and construction to provide uniform electrical and mechanical control . . . and assure utmost dependability . . . under all operating conditions.

Two sizes: Model "J" 50-watt and Model "H" 25-watt. Linear or Taper wire-wound, in various resistances, with "off" position, as required. Totally enclosed in a compact, corrosion-resisting metal container. Complete with knob as shown. Write, wire or phone for further information.

OHMITE MANUFACTURING CO.
4946 FLOURNOY ST., CHICAGO 44, U. S. A.

Be Right with OHMITE
RHEOSTATS • RESISTORS • TAP SWITCHES

"I'll tell you what I'd like for Christmas, mister"

"This sounds like the old days when I used to hint to the folks about the things I wanted — like the electric razor that made me feel so grown-up just to think about!

"But this year — well, what I want comes in an awfully big package. What I want — and all the fellows I'm teamed-up with, too — is to see a few more B-29's around these parts!

"Yes, a B-29 costs a hell of a lot of money. $600,000, they tell me! But you ought to see what one of those babies can do to the plenty-tough guys in front of us! And I'd hate to tell you what it costs *not* to have that kind of help. It costs — well, the way we reckon costs around here is in how many kids won't make the trip back home."

★

Let's forget that a War Bond is the safest investment in the world. Let's forget, even, that the more War Bonds you buy the more you help curb inflation, and build a firmer future for all of us. Let's remember only one thing: this war is far from over; the war in the Pacific is one of tremendous distances — and correspondingly great costs; yet a brutal adversary that is fighting savagely every inch of the way must be defeated. Let's help the boys who have *that* job to do by doing *our* job with War Bonds. Help shorten the war—with an *extra* Bond today.

Reprints of the above message, for poster use, will be gladly furnished without charge.

AMERICAN FLANGE & MANUFACTURING CO. INC., 30 ROCKEFELLER PLAZA, NEW YORK 20, N.Y.
TRI-SURE PRODUCTS LIMITED, ST. CATHARINES, ONTARIO, CANADA

MERIAM Announces

A New Altimeter Test Unit for Testing Altimeters and Rate-of-climb Indicators

THIS new unit is very compact, and simple to operate. It consists of chamber, integral vacuum pump, control valves, and electrical equipment.

It is complete requiring no other accessories for complete testing of altimeters when using a master standard altimeter.*

**A standard Meriam well type manometer can be furnished with scale graduated directly in altitude if required.*

THIS Altimeter Test Unit fills a long standing need in the field of testing.

ASK FOR BULLETIN 26

Unit with cover open

Among the many features of the Meriam Altimeter Test Unit are:

1. Chamber designed for testing four instruments at one time.
2. Internal instrument mounting plate removable from chamber for independent mounting of instruments.
3. Vibrator included which eliminates drag on indicating pointer of instruments.
4. Heavy duty vacuum pump which will evacuate chamber to 2 inches of mercury absolute or equivalent of 60,000 feet.
5. Metering valve for accurate control of vacuum exhaustion and rate of vent.

THE MERIAM INSTRUMENT COMPANY

Since 1911

10928 Madison Avenue • Cleveland 2, Ohio

MERIAM — THE INSTRUMENT PEOPLE

First in Flight

. . . that's FLIGHTEX year after year — because FLIGHTEX is lighter, stronger, smoother airplane fabric that surpasses U. S. Army and Navy specifications.

World's Premier Airplane Fabric

FLIGHTEX FABRIC

FLIGHTEX

FLIGHTEX FABRICS, INC.
93 Worth Street, New York 13, N. Y.

Leading Manufacturers of Fabric and Tapes for the Aircraft Industry

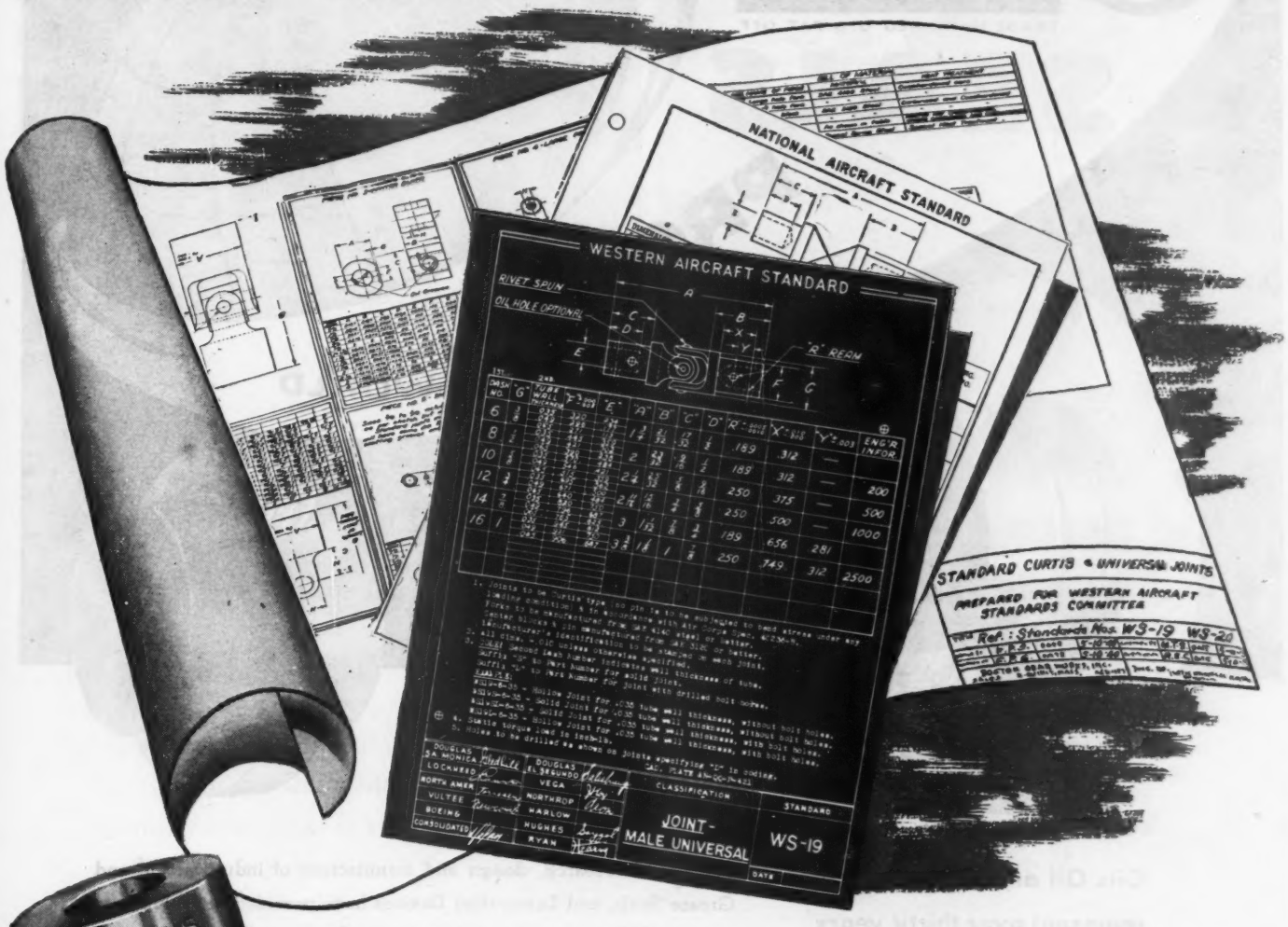
Export Representative—Aviquipo, Inc. 25 Beaver St., N. Y. Cable Address—"Aviquipo"

RESALE DISTRIBUTORS

AERONAUTICAL TRADING CO., Jamaica, N. Y.
AIR TRANSPORT EQUIPMENT, INC., Garden City, N. Y.
AVIATION SUPPLY CORP., Hapeville, Ga., Orlando, Fla., Charlotte, N. C., Nashville, Tenn.
BOB TRADER-AERO SUPPLY, Pittsburgh, Pa.
INTER CITY AVIATION, INC., East Boston, Mass.
KARL ORT, York, Pa.
LEAVENS BROS. AIR SERVICE, LTD., Toronto, Canada.
PACIFIC AIRMOTIVE, Burbank, Cal., Oakland, Cal.
SNYDER AIRCRAFT CORP., Chicago, Ill., Columbus, Ohio.
SUPPLY DIVISION, INC., Robertson, Mo., Memphis, Tenn.
THE AIRCRAFT STEEL & SUPPLY CO., Wichita & Kansas City, Kansas, Dallas, Texas.
VAN DUSEN AIRCRAFT SUPPLIES, Minneapolis, Minn., Waterloo, Iowa.

In the Air *or on the Ground...*

CURTIS SETS THE STANDARD



FROM Planning Board through production — Standard specifications for every part must be drafted and rigidly held to secure accuracy and quality in our fighting planes, trainers, bombers and transports.

"Aircraft Standards Committees" in 1940 found that Curtis Universal Joint "Standards" answered their needs.

Curtis "Standards" for Universal Joints, in use for many years, fill every requirement for engine controls — retractable landing gear — control flaps — auxiliary power controls — elevator spars or in any installation requiring out-of-line transmission of power or rotation of control shafting around corners or at angles. The Curtis "Standards" were the basis in establishing "Aircraft Production Standards" followed by leading aeroplane manufacturers today.

Curtis Universal Joints are to be found in the thousands of planes used by all branches of the Armed Services in the four corners of the world. . . At home too . . . in the many machine tools where Curtis Universal Joints transmit power in multiple drill presses, grinders, milling machines, etc. . . . the Curtis "Standards" have proven that knowledge gained through years of experience in production can, and will, lick difficult problems.

This experience is yours for the asking . . . send us your universal joint problems. Curtis Engineers are at your service.

CURTIS UNIVERSAL JOINT CO. INC.

SPRINGFIELD, MASS. • BOSTON GEAR WORKS, NO. QUINCY, MASS., SOLE DISTRIBUTORS

GITS

TRADE MARK REG U. S. PAT. OFF.

SEALS

PROVED... AROUND THE WORLD

Gits Oil and Grease Seals represent over thirty years of lubrication research.

Specialized research, design and manufacture of industrial Oil and Grease Seals, and Lubricating Devices have provided the solution to many problems years ahead of the times. Our war effort has hastened this research—crowding the achievements of many years into but a few —to meet the demands of ever closer tolerances and higher standards of efficiency of both mechanized units and industrial equipment. These years of scientific research have developed the intangible values that insure dependable performance under all conditions, found in all Gits Lubricators. These years of specialization have indelibly specified the name Gits wherever lubrication is an essential. Let Gits solve your problems the scientific way.

GITS BROS. MFG. CO.

1859 South Kilbourn Avenue • Chicago 23, Illinois

Exclusive for over 30 years

"MADE BY NATIONAL SCREW"

means *Quality Control*

Bench inspection.

Inspection under magnifying glass.

1944 outlining procedures to be followed in establishing Quality Control Rating for the National Screw & Mfg. Company. The Air Technical Service Command is pleased to advise that Quality Control procedures at your facility are such as to warrant approval. Therefore, the National Screw & Mfg. Company has been listed on the Army Air Forces records as a Quality Control "APPROVED" facility.

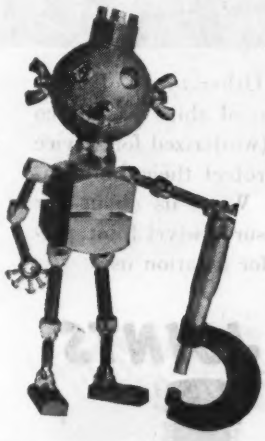
Checking pitch diameters with roller snap gauges.

Magnetic inspection by Magnaflux machine.

As a principal source of supply for aircraft fasteners, we have developed facilities for achieving tolerances formerly unheard of in bolts, nuts and screws.

There is only one way to insure rigid adherence to the quality required by the Air Forces, with a production of millions of parts daily. That is by a system of inspection that is complete and foolproof.

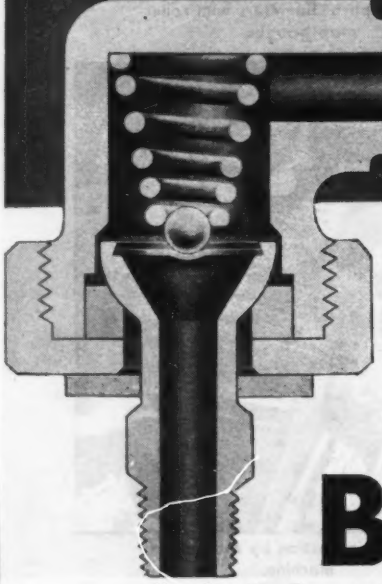
The excerpt reproduced above from a recent letter of formal approval from the Air Technical Service Command indicates how well National Screw has achieved this goal.



National HEADED AND THREADED PRODUCTS

THE NATIONAL SCREW & MFG. CO., CLEVELAND 4, O.

BARCO IS PILING UP TIME ON THE B-29



On every mission, Barco Flexible Joints protect the vital fluid-conveying pipes of the Boeing B-29. Barco's responsive movement absorbs the destructive vibration and shock... guards the oxygen re-breather system . . . gives flexibility to brake, and retracting mechanism hydraulic lines. Other types of fighting and commercial ships use Barco Flexible Joints (winterized for service conditions) to protect their fluid-conveying systems. Write us about our 3000-pound pressure Swivel Joint, prepared specially for aviation use.

BARCO ***FLEXIBLE JOINTS***

"MOVE IN EVERY DIRECTION"

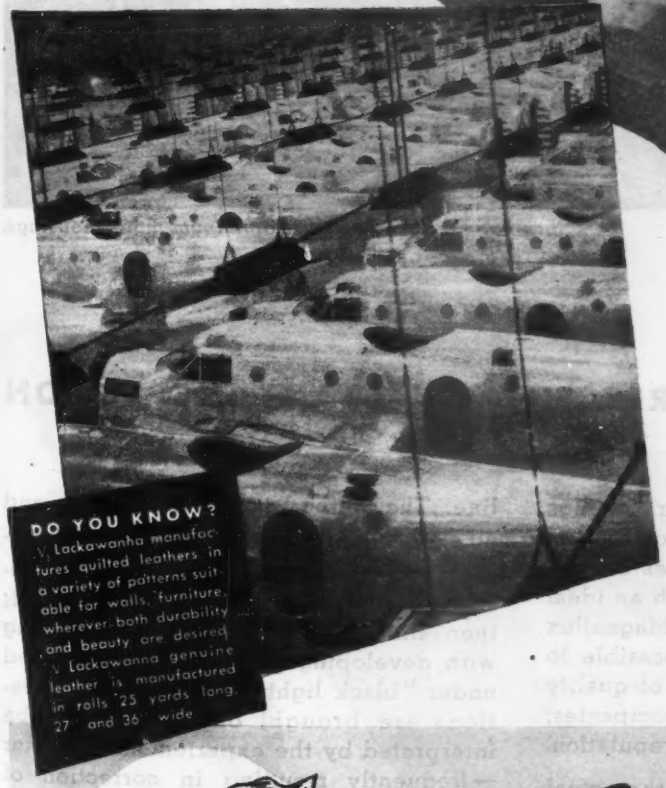
Manufacturing Company, Not Inc., *Aircraft Products Division*
1827 Winnemac Avenue, Chicago 40, Illinois

The Free Enterprise System is the Salvation of American Business

LIKE MOST OF AMERICA'S AIRPLANES

THESE BEECHCRAFT TRAINERS CARRY

Lackawanna LEATHER UPHOLSTERY



DO YOU KNOW?

V Lackawanna manufactures quilted leathers in a variety of patterns suitable for walls, furniture, wherever both durability and beauty are desired.

V Lackawanna genuine leather is manufactured in rolls 25 yards long, 27" and 36" wide.

DESIGNERS and engineers specify Lackawanna wherever leather upholstery is used in practically all of the leading war and transport planes made in America today. The reason: Lackawanna Leathers are tanned to the exact requirements of the jobs they have to do. For instance: Our Lite-Flite leather, tanned especially for aircraft, weighs only 2 oz. per square foot . . . yet it's sturdy, sound-absorbing and luxurious as only genuine leather can be.

ARMY E NAVY

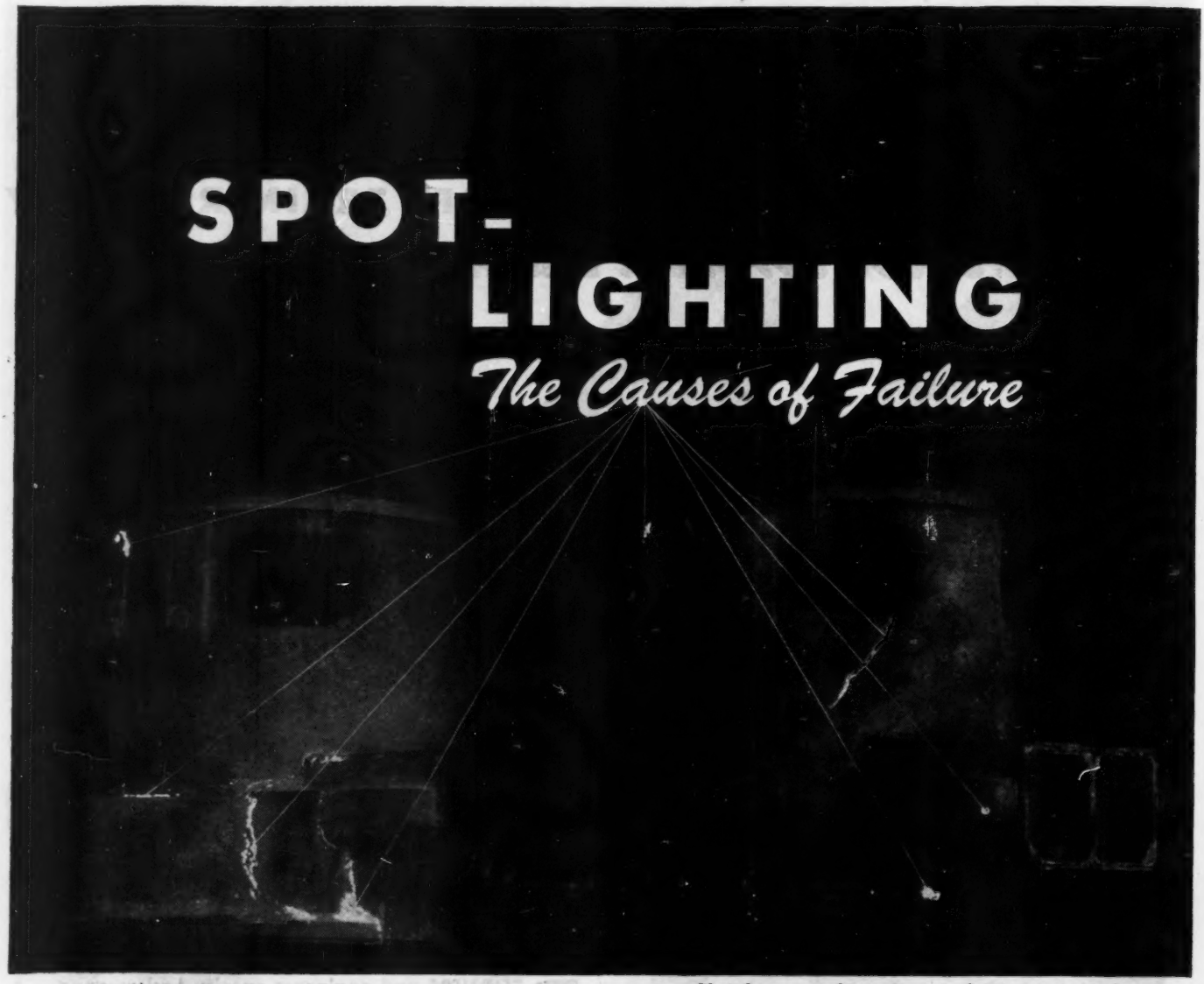
THE Lackawanna Leather CO.

720 GRAND AVE., HACKETTSTOWN, NEW JERSEY

Sales Offices: NEW YORK CITY...512 FIFTH AVE. • BOSTON...334 CONGRESS STREET • CHICAGO...6748 NO. ASHLAND AVE.

Agents: PACIFIC HIDE AND LEATHER CO.

LOS ANGELES...716 E. WASHINGTON BLVD. • SAN FRANCISCO...50 HAWTHORNE STREET • SEATTLE....1434 10TH AVE.



Shrinkage cracks in 2 cast aluminum motor housings.

ZYGLO*

FLUORESCENT PENETRANT INSPECTION

Suppose that hereafter, in your castings all shrinkage cracks, hot tears, cold shuts and other surface discontinuities carry a shining signal light. Under such an ideal condition, as clients of the Magnaflux Corporation can testify, it is possible to maintain the highest standard of quality in any group of competing companies, and win leadership as well as reputation.

"Spot-lighting" such flaws is the actual result of installing the Zyglo Method. Four simple steps are performed rapidly on every part that comes off the production line. The method is non-destructive and all parts passing inspection can be used.

First, Zyglo penetrant carrying fluorescent material is flowed over the part; then after washing, drying, and dusting with developing powder, it is examined under "black light." Illuminated indications are brought out which can be interpreted by the experienced inspector —frequently resulting in correction of the cause.

Get the full story of Zyglo Inspection from a new bulletin now available. Write for it.

**ZYGLO . . . the Trade Mark of Magnaflux Corporation applied to its equipment, material and methods for fluorescent penetrant inspection.*

MAGNAFLUX CORPORATION

5906 Northwest Highway, Chicago 31, Illinois

NEW YORK • DETROIT • DALLAS • LOS ANGELES • CLEVELAND • BIRMINGHAM

HANSEN Couplings

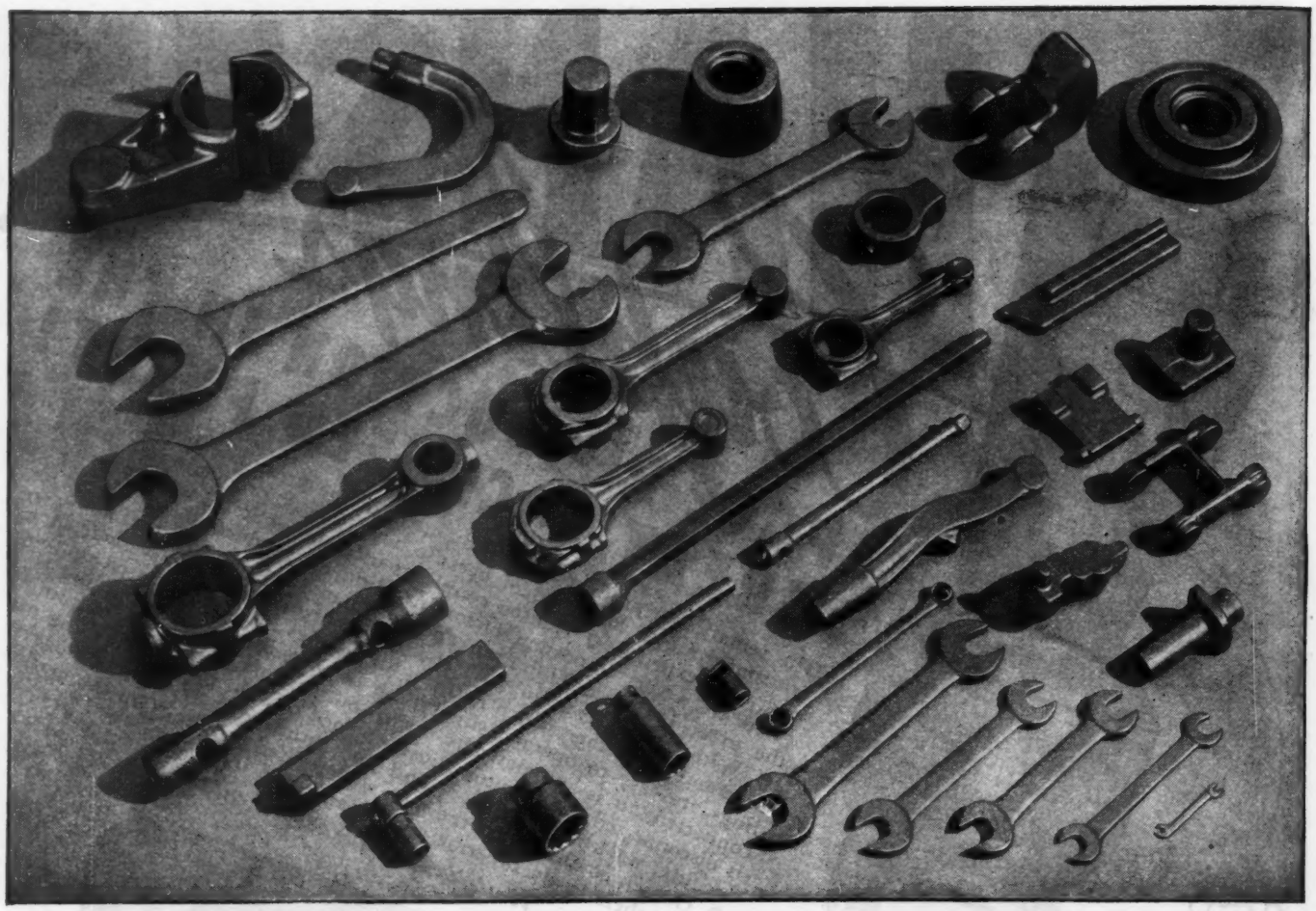
PACE PRODUCTION IN THE GREAT LOCKHEED PLANT!

The remarkable production records made in the great Lockheed plant are something to be proud of because here is peak production at low operating expense. ● Hansen couplings used throughout the Lockheed plant are a very important factor in piling up production records on the great Lockheed Lightning and the giant transport Constellation. ● With Hansen couplings it's speed, ease of operation, no wastage of time and no leakage which means a big savings in air. ● Hansen couplings are easy to operate; slight push of plug into socket, coupling is connected, air is automatically turned on. Easy pull on sleeve, coupling is disconnected, air is automatically turned off. No twisting, turning or locking; no kinking of hose and no jamming or freezing of parts. ● Hansen couplings are the most widely used couplings on the market due to their vastly superior performance and long life.

Write for free industrial catalog.

HANSEN MANUFACTURING CO.

1786 EAST 27th STREET • CLEVELAND, OHIO



Herbrand

PRECISION FORGINGS

Upset or Drop Forged--Any Shape or Size up to 200 lbs.

You who use forgings in war production work won't have a problem of faulty forgings if the job is being done by Herbrand. Our expert hammersmiths, who have made forging their life business, maintain uniform dimensions and close tolerances producing forgings which are free from defects.

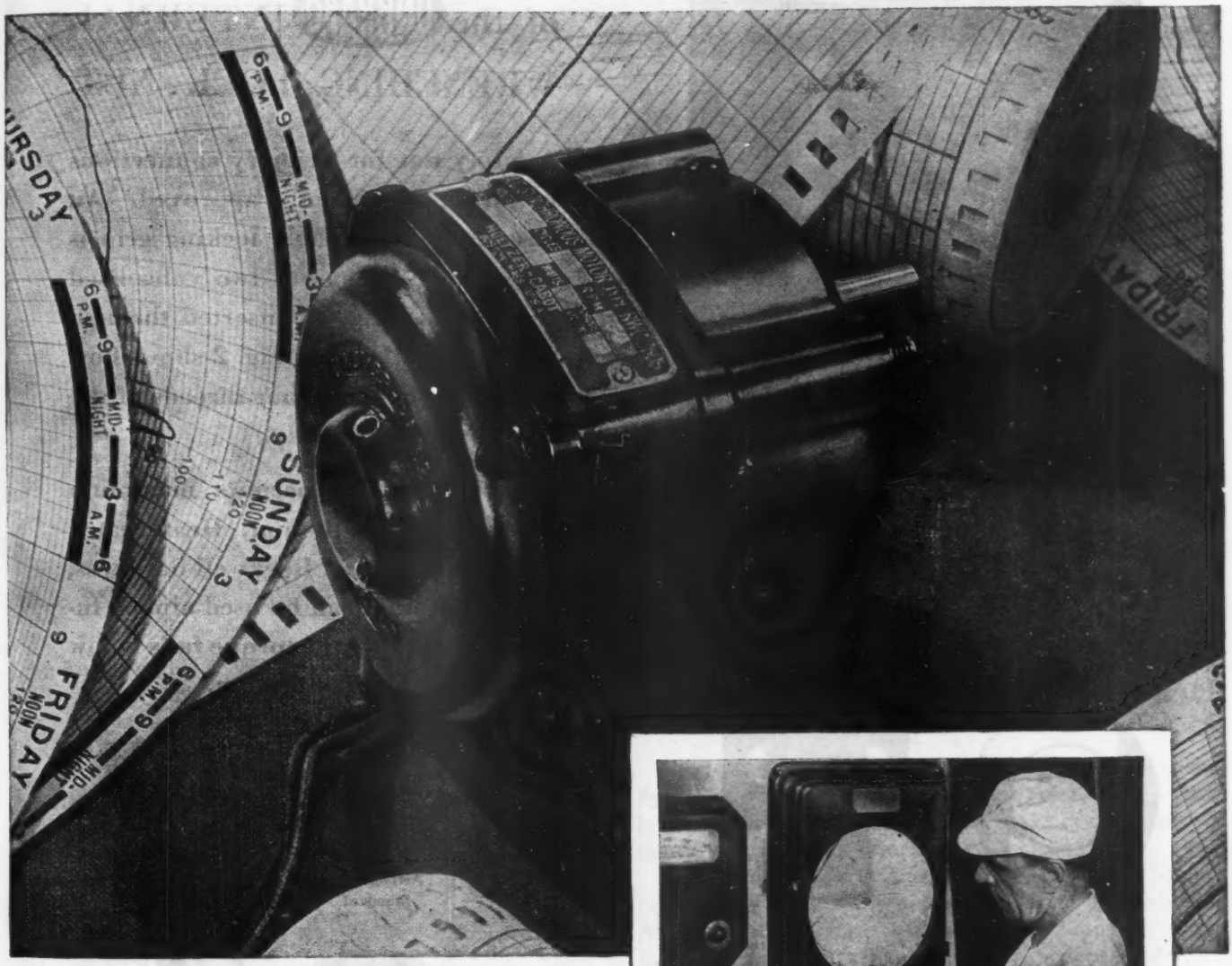
Since our organization was founded in 1881, Herbrand has never lost sight of the importance of producing quality products conforming to exacting specifications.

Today the counsel of the Herbrand engineering staff is available to help solve present war production problems, or for post-war planning . . . Your inquiries are solicited.

THE HERBRAND CORPORATION
FREMONT, OHIO

Increased Power and Constant Speed

...YET FITS MOTOR SPACE AVAILABLE



Typical Recorder Powered with Holtzer-Cabot Motor

The requirements of a manufacturer of instruments called for a constant speed motor that had more power than a standard clock motor previously used, yet still fitted the original space allowed.

Holtzer-Cabot designed the special synchronous motor, illustrated above, which not only filled the performance and space requirements, but saved the manufacturer the cost of redesigning and retooling to take a larger motor, and also made it possible to service instruments in customers' plants which had the old type of motor.

The specialized business of Holtzer-Cabot is the designing and building of special fractional H. P. motors to meet special requirements.

Although today our entire facilities are devoted to building special motors for military use, our motor development engineers will gladly discuss your post-war fractional H. P. motor requirements with you.

Special Motors Designed to Fit the Application

HOLTZER-CABOT

Division of First Industrial Corporation

Designers and Builders of Special Fractional HP Motors and Electrical Apparatus

125 AMORY STREET, BOSTON 19, MASSACHUSETTS • CHICAGO, ILLINOIS • NEW YORK, NEW YORK • PHILADELPHIA, PENNSYLVANIA

INSURANCE FOR *SAFETY...*

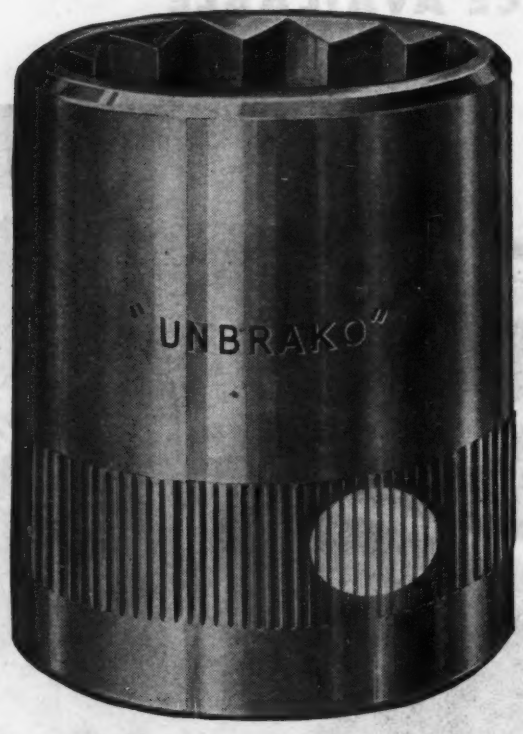


FIG. 1

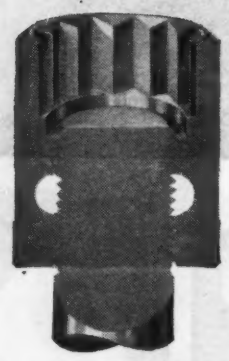


FIG. 2

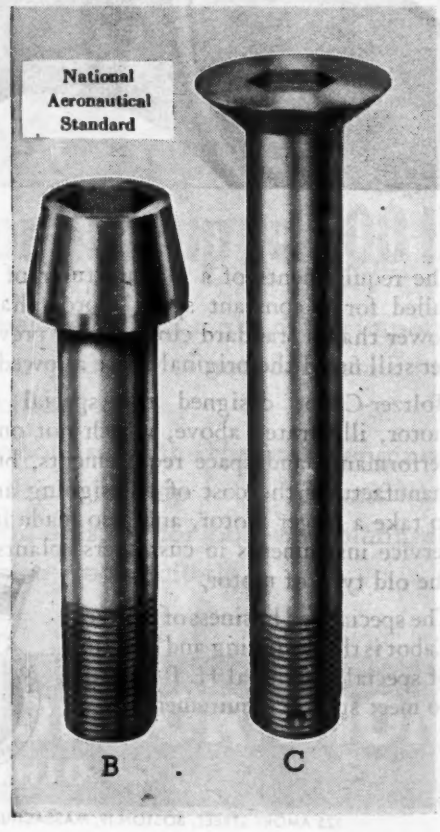
the outstanding component of the UNBRAKO INTERNAL WRENCHING LOCK NUT

A safety nut for primary connections in aircraft—officially approved. An absolutely dependable locking grip is achieved by means of two vulcanized fibre plugs (Fig. 1) inserted through the body of the nut. Fig. 2 shows how these plugs contact four threads of the bolt, gripping it firmly.

This design also permits maximum thread length in the nut. Heat-treated to a high degree of Rockwell hardness, the "Unbrako" can be used almost indefinitely before the torque falls below the Wright Field minimum.

"UNBRAKO" INTERNAL WRENCHING and FLUSH-HEAD BOLTS

Our INTERNAL WRENCHING BOLT (B) and 100° FLUSH-HEAD SOCKET BOLT (C) fully meet the high degree of precision demanded by the aviation industry. They are made to tolerances so extremely close as to be practicable only by our long and extensive experience in precision work. The internal wrenching feature facilitates compact designs—a saving in weight, material and cost.



Over 40 years in business

STANDARD PRESSED STEEL CO.

BOX 566 JENKINTOWN, PA.

Boston • Detroit • Indianapolis • Chicago • St. Louis • San Francisco

The Ford-Ferguson MOTO-TUG is a compact power unit, specially designed for the variety of pulling jobs found on land and sea airports.

READY TO GO—The MOTO-TUG starts instantly and has plenty of power to move singlehanded the heaviest four motored bomber on the runway. The single rear wheel model has a drawbar pull of 2,500 pounds; dual wheel model, 4,000 pounds.

EASY TO HANDLE—The MOTO-TUG is 46″ high and 58″ wide. It is low enough for driving under most wing and tail assemblies and in crowded hangars its 9′ 8″ turning radius makes possible "hair-pin" turns.

SAFE TO USE—With the MOTO-TUG, safety is first. A spark arrester on the exhaust eliminates a possible source of fire. A starter that will not operate when the tractor is in gear minimizes chances of crashing into personnel or equipment.

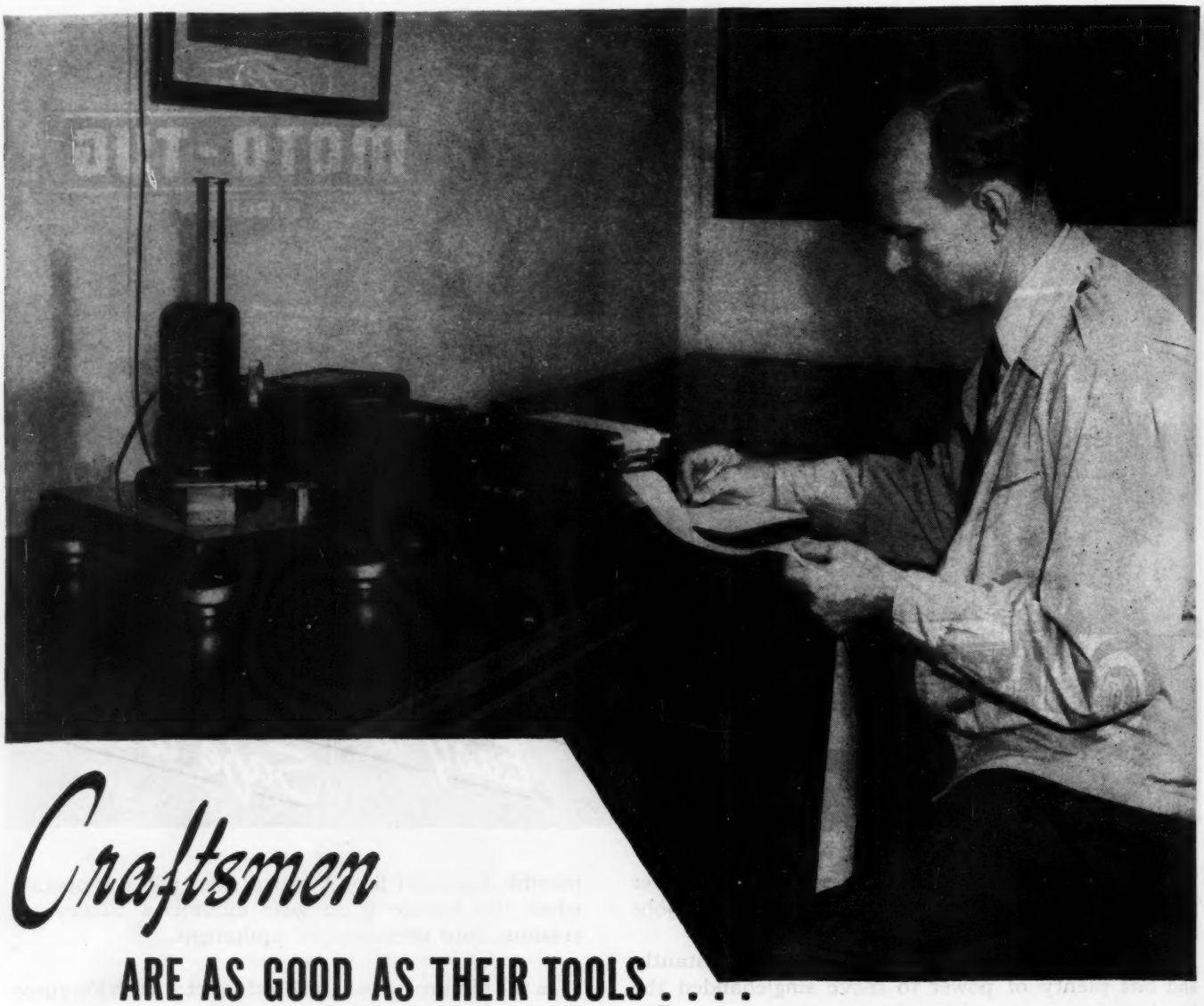
★ ★ ★

In the picture below, the Ford Tractor with Ferguson System is shown towing a light plane. Relieving heavy-duty units during traffic peaks is *only one* of many jobs it was designed to do.

With this tractor and attachments you will be surprised how far maintenance costs can be reduced. Attachments include a heavy-duty mower, front mounted sweeper, a blade terracer, scoop, loader, to mention only a few. These attachments are operated, hydraulically, with a finger tip control lever. The tractor operator is the only man needed.

For Further Information, Write

HARRY FERGUSON, INC. • DEARBORN, MICH.



Craftsmen

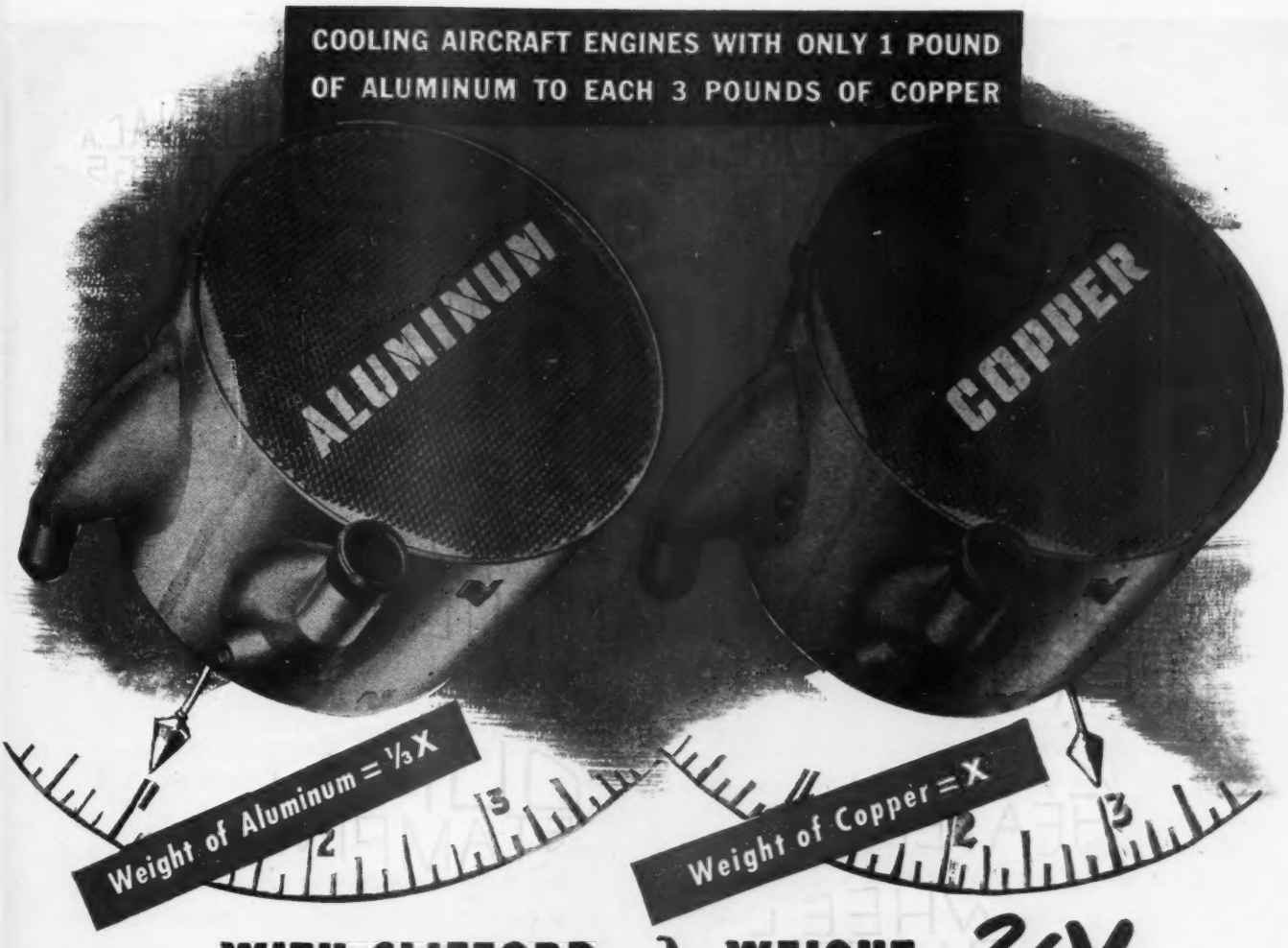
ARE AS GOOD AS THEIR TOOLS . . . .

● Up at the Yale and Towne Manufacturing Company in Stamford, Connecticut, craftsmen have been making the well-known "Yale" locks and builders' hardware for many years. The enviable reputation enjoyed by this company is the result of their insistence for fine quality.

Now as a major contributor to the war effort, Yale and Towne are producing hydraulic pistons and cylinders. Constantly endeavoring to improve their already superior quality, they use the Brush Surface Analyzer in both laboratory and shop. With this instrument they are able to study surface finishes, accurately measured to one millionth of an inch (.000001") from chart recordings instantly made as the specimen surface is explored.

THE BRUSH DEVELOPMENT COMPANY

3443 PERKINS AVENUE • CLEVELAND 14, OHIO


COOLING AIRCRAFT ENGINES WITH ONLY 1 POUND
OF ALUMINUM TO EACH 3 POUNDS OF COPPER
ALUMINUM
COPPER
Weight of Aluminum = ⅓X
Weight of Copper = X

WITH CLIFFORD FEATHER-WEIGHTS } **WEIGHT SAVING = 2/3X**

Feather-Weight all-aluminum oil coolers and coolant radiators . . . made of Hydron extruded tubing . . . brazed by Clifford's patented method . . . represent *"one of the greatest contributions in recent years to reduction in weight of equipment items for aircraft."* So reports the Society of Aeronautical Weight Engineers in presenting Seal of Approval Certificate No. 44-16.

Battle-tested in two types of USAAF fighters, saving approximately 120 pounds in one and potentially more than 300 pounds in the other, Clifford Feather-Weights are now being developed in elliptical and oblong shapes for new warplane models.

How about Feather-Weights for post-war planes? Although our production is 100% in war work, our engineering department occasionally finds time to do a little looking ahead. Already we're in correspondence with several aircraft manufacturers who have an eye for the future . . . who can visualize the increased payload, speed, range, obtainable by replacing heat-deteriorating, heavy-weight copper with heat-treatable Feather-Weight Aluminum in oil coolers and coolant radiators. Maybe we can do some planning with you? Let's talk it over.

CLIFFORD MANUFACTURING CO.
562 E. First St., Boston 27, Mass.

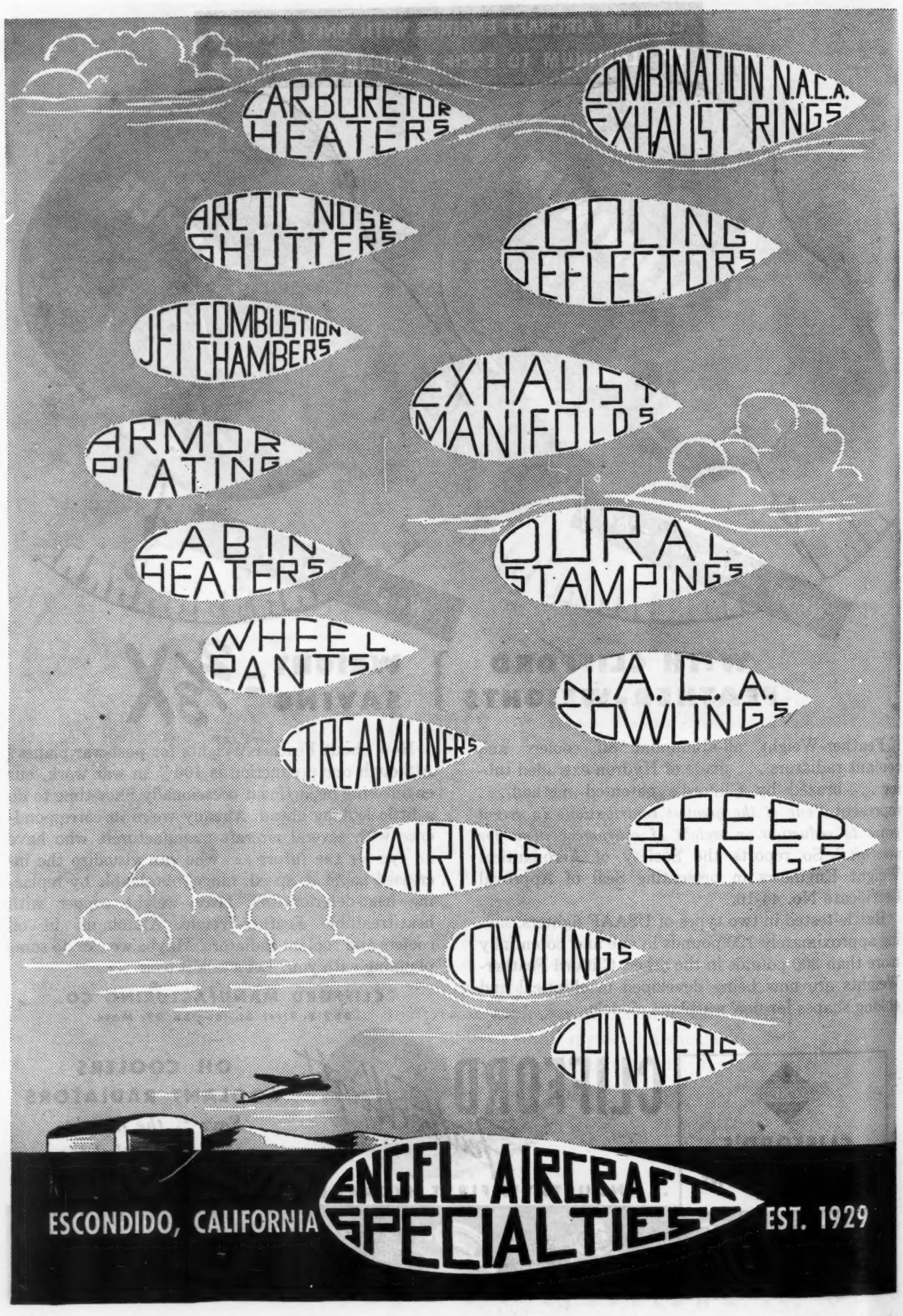
HYDRON

CLIFFORD'S
"HYDRON" BELLOWS

CLIFFORD *Feather Weight*

OIL COOLERS
COOLANT RADIATORS
Save ⅔ the Weight
. . . same size and shape

. . . INDUSTRY'S FIRST HYDRAULICALLY-FORMED BELLOWS


CARBURETOR HEATERS
COMBINATION N.A.C.A. EXHAUST RINGS
ARCTIC NOSE SHUTTERS
COOLING DEFLECTORS
JET COMBUSTION CHAMBERS
EXHAUST MANIFOLDS
ARMOR PLATING
CABIN HEATERS
DURAL STAMPINGS
WHEEL PANTS
N. A. C. A. COWLINGS
STREAMLINERS
FAIRINGS
SPEED RINGS
COWLINGS
SPINNERS
ESCONDIDO, CALIFORNIA
ENGEL AIRCRAFT SPECIALTIES
EST. 1929

NOW IS THE TIME TO RE-EXAMINE YOUR AVIATION ADVERTISING PROGRAM

AVIATION is entering the most important marketing transition in its history. The selection of aviation advertising media must be more critical than ever before. With some 36 publications from which to choose, the keenest judgment and analysis must be exercised by the advertising buyer to select those that offer adequate coverage of the *true* buying influences of aviation. We believe the most rational approach is through a clear definition of the structure and buying functions of the aviation market.

Aviation's market structure is simple. It is divided into three, and only three, major divisions:

1—Military Aviation . . . calls for continuing coverage—for the military has always been and will continue for some time to be aviation's biggest dollar customer.

2—Air Transport . . . calls for more intensified coverage than ever as our swiftest-growing public carrier.

3—Personal Aircraft . . . calls for strong coverage of the key men who will sell and service planes, distribute parts and accessories, operate airports—the fixed-base operators, distributors and airport managers.

The functions of the industry are manufacturing, operation, maintenance and distribution.

Frequently misinterpreted as divisions, they are, in fact, functions *within* the three major divisions.

They are closely related and interdependent. So closely, in fact, that it is almost impossible to say where one stops and the other starts.

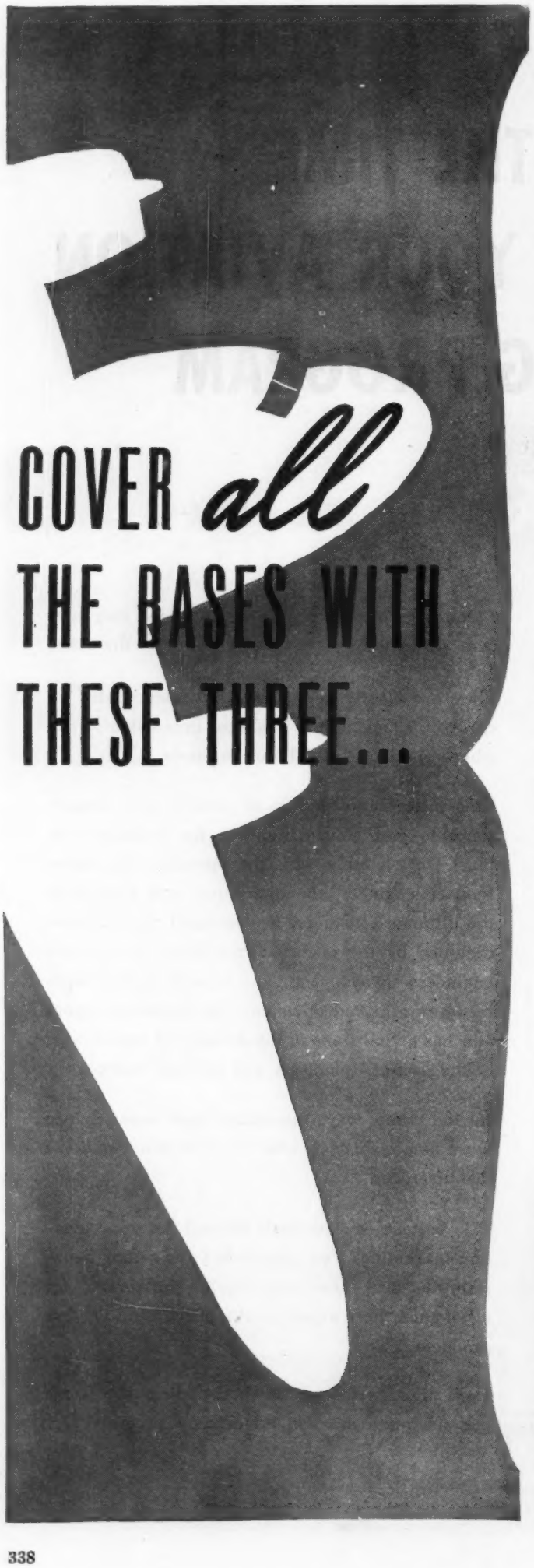
This interrelationship is of utmost sales importance to you. For in aviation the manufacturer must work closely with the operator, the maintenance engineer, the distributor and even with the ultimate consumer. No transport plane is ever designed by the manufacturer alone. The airline engineers always sit in. The same is true in military aircraft. And obviously the fixed-base operator has a vital stake in the design and engineering of the personal plane he will sell and service.

In the same way, operations and maintenance work as a team both with the distributor and the manufacturer.

This pattern repeats itself throughout your aviation marketing. You cannot in your selling separate the four functional buying influences, for *all* of them play a part in the purchasing of your products.

Here, then, is the key to the building of a sound and adequate aviation advertising program . . .

(over)



AVIATION

. . . for foundation coverage of aviation's multiple buying influences.

Aviation **serves not just one, or two, but all four of the industry's buying influences . . . Manufacturing—Operation—Maintenance—and Distribution.**

For these four functions are interdependent and interrelated. The men of each of them exert a vital buying influence that affects all your aviation selling—whether to the military aviation market, the air transport market, or the personal aircraft market.

Researchers, designers, engineers and production executives are concerned not only with the building of airframes and components but also with the operation, maintenance and distribution of their products after they leave the factory. Conversely, operators, maintenance engineers and distributors exert strong influence on the designing and engineering of the planes they will later sell and service. Throughout all the functional activities you find a close intermeshing of interests.

That is why *Aviation's* editorial policy has for 28 years been the serving of *all* the industry's interlocking interests . . . Research, design, engineering and production. Operation, finance, distribution and maintenance in all its phases. Legislation and administration.

That is why *Aviation* maintains the largest staff of editorial specialists in the field of aeronautical publishing. That is why *Aviation* has 42,000 paid subscribers representing *all* functions of the industry.

To you *Aviation* offers comprehensive advertising coverage of all aviation's buying influences—the FOUNDATION MAGAZINE on which to build your aeronautical advertising schedule.

YOUR REQUEST will bring the whole story of "AVIATION—*foundation magazine* on your aviation schedule."

AVIATION NEWS

. . . for intensive coverage of aviation's 10,000 key men.

The 10,000 paid subscribers of *Aviation News* offer you one of the most influential buying groups in U. S. industry today. They are the top executives of our aircraft builders, and of the plants that supply them with engines, propellers, parts, equipment, instruments and accessories. They are the military officials and civilian administrators who direct our government's huge and expanding interests in aviation development. They are the leaders and planners of U. S. airlines. They are the key distributors of tomorrow They are the men who control the buying decisions in the many, many businesses that have a vital stake in the future of aviation.

To these leaders, *Aviation News* supplies each week the informational background so essential in decision-making, in market-planning, in laying the groundwork for aviation's future.

Aviation News (the only aeronautical weekly) was created specifically to speed the news and its implications in fast, readable, interpretive reports to the men who are molding the postwar shape of aviation.

Every one of *Aviation News'* 10,000 key audience subscribed to *Aviation News* within 10 months after its first issue. This is a circulation record without precedent in its field. For remember, *Aviation News'* subscription rate is $5 a year, not the usual $3. And its circulation is truly selective, subscription sales being carefully confined to the very top of aviation's management men in industry and in government. So swift has been the acceptance of this new-to-aviation journalism, that within its first year *Aviation News* has been accepted for membership in the Audit Bureau of Circulations.

To you *Aviation News* offers timely, direct and intensive coverage of the top men of the industry.

AIR TRANSPORT

. . . for intensive coverage of our swiftest-growing transportation market.

In the span of less than 20 years a new, major transportation industry has been developed—bringing you huge new markets and marketing potentialities. Air transport has taken its place alongside the railroad, marine and automotive industries as one of our great public carriers of people and cargo.

Air Transport serves the builders and planners of this swiftly-growing industry—*and serves them to the exclusion of all other interests.* Among *Air Transport's* 10,000 paid subscribers you find the administrative heads, operation and line maintenance and overhaul executives, engineers, designers and their key supervisors and personnel—the financial and legal interests who back them—the military and government authorities who promote air transport expansion—the planners and builders of the $800,000,000 program for airport and airway facilities—the transport manufacturing executives and the key men of thousands of manufacturing suppliers to the industry.

Within its first year, *Air Transport* has become the strong national voice of its industry. To the extent that air transport's key men have fully subscribed to its 10,000 paid (A.B.C.) circulation. This is a record of unusual significance (1) because circulation is carefully confined to airlines men, aircraft and parts manufacturing executives, military and government authorities and (2) because *Air Transport's* subscription price is $5 a year rather than the traditional $3.

To you *Air Transport* offers direct and intensive advertising coverage among the builders of this specialized business.

McGRAW-HILL PUBLISHING CO., 330 West 42nd St., NEW YORK 18, N. Y.

YOUR COPY of "Aviation's 10,000 Key Men" is waiting. Write for it.

YOU'LL WANT all the facts. Ask for "The Builders of Air Transport."

DESIGNED FOR TRAINER AIRCRAFT....

TWO-BLADE *Feathering Propeller*

by

ROTOL
LIMITED

ROTOL LIMITED, ENGLAND • *Canadian Representatives* BRITISH AEROPLANE ENGINES LIMITED • MONTREAL

Wellman MAGNESIUM SAND CASTINGS

OFFER *IMPORTANT* ADVANTAGES FOR YOUR PRODUCTS ON THIS LIST*

AS you develop new products or redesign those you made prewar, keep in mind this fact: *Extreme lightness with high strength can be obtained by using Wellcast magnesium castings.* Our thirty-three years' experience, modern laboratory, foundry, and pattern shop are among the important reasons why we believe we can work advantageously with your company. Wire or write and we shall be glad to have a field engineer call.

Castings in
ALUMINUM
(Heat Treated)
MAGNESIUM
AMPCO BRONZE
BRONZE • BRASS
•
Patterns in Metal and Wood
•
WELLMAN
***Means* WELL-CAST**

THE WELLMAN BRONZE & ALUMINUM COMPANY
GENERAL OFFICES:
2533 EAST 93rd STREET • CLEVELAND 4, OHIO
CASTINGS X-RAY INSPECTED

DESIGNED FOR TRAINER AIRCRAFT....

TWO-BLADE *Feathering Propeller*

by

ROTOL
LIMITED

ROTOL LIMITED, ENGLAND • *Canadian Representatives* BRITISH AEROPLANE ENGINES LIMITED - MONTREAL

Wellman MAGNESIUM SAND CASTINGS

OFFER *IMPORTANT* ADVANTAGES FOR YOUR PRODUCTS ON THIS LIST*

AS you develop new products or redesign those you made prewar, keep in mind this fact: *Extreme lightness with high strength can be obtained by using Wellcast magnesium castings.* Our thirty-three years' experience, modern laboratory, foundry, and pattern shop are among the important reasons why we believe we can work advantageously with your company. Wire or write and we shall be glad to have a field engineer call.

Castings in

ALUMINUM
(Heat Treated)
MAGNESIUM
AMPCO BRONZE
BRONZE • BRASS

•

Patterns in Metal and Wood

•

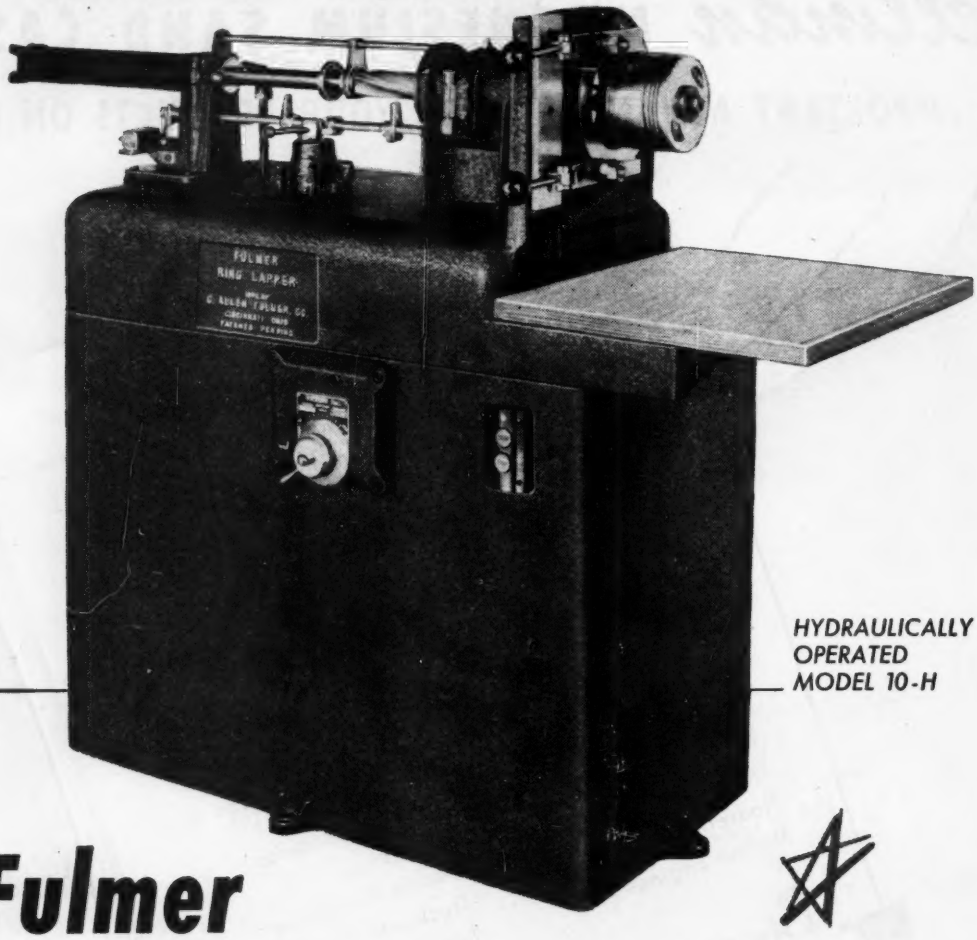
WELLMAN
***Means* WELL-CAST**

THE **WELLMAN** BRONZE & ALUMINUM COMPANY

GENERAL OFFICES:
2533 EAST 93rd STREET • CLEVELAND 4, OHIO

CASTINGS X-RAY INSPECTED

REDUCES "BREAK-IN" TIME FROM HOURS TO MINUTES



HYDRAULICALLY OPERATED MODEL 10-H

Fulmer Piston Ring Lapper

To "break-in" piston rings in an aircraft engine requires from 6 to 24 hours of test stand operation. The Fulmer Piston Ring Lapper reduces this time to a few minutes!

The hydraulically operated model illustrated is extremely flexible. It has a wide range of reciprocating speeds, extremely precise control and adequate power to handle the largest aircraft cylinders in use. The unit is self-contained with the base of the machine carrying the hydraulic tank, pump and motor.

Only 10 to 25 strokes will lap in a conventional set of rings. No guesswork—how rings fit the cylinders can be seen before the engine is built up. No tearing down engines because rings do not seal properly. The engine can carry full throttle from the start, with proper control of oil.

The Fulmer Piston Ring Lapper is simple to operate. Widely used by the Army and Navy. Two models available: Model 10-H (illustrated above) for hydraulic operation and Model 10 for air operation.

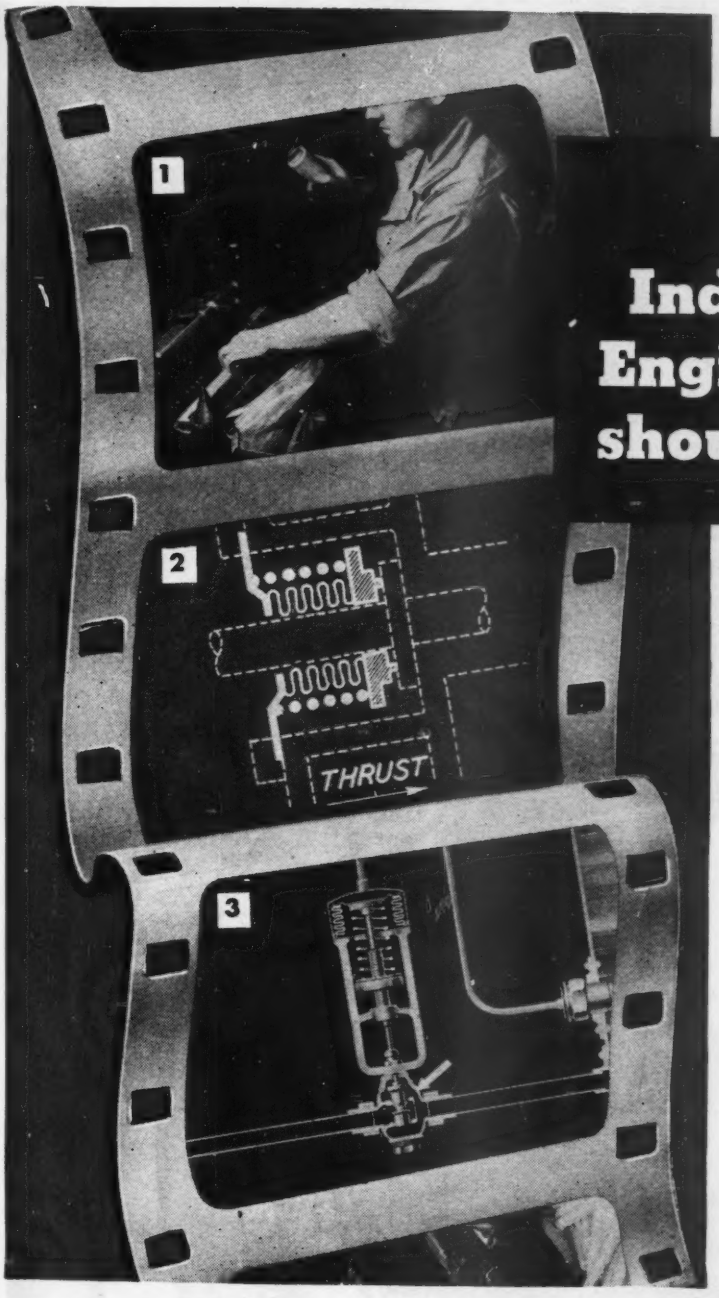
Write Today for Complete Information

C. ALLEN FULMER CO.

1218 FIRST NATIONAL BANK BLDG., CINCINNATI 2, OHIO

FULMER
PRECISION AIRCRAFT SERVICE EQUIPMENT

ROD BORERS · HONING MACHINES · PISTON RING LAPPERS · SPECIAL MACHINERY



Every Industrial Executive, Engineer and Designer should see this picture

SIMPLE as bellows are, words often fail to show the limitless design possibilities inherent in these versatile metal diaphragms. Too often many engineers have assumed that bellows only had application in a few fields, when actually they have been successfully applied to scores of designs in dozens of different industries.

"*The Story of Metal Bellows*" is an interesting and informative sound film, vividly showing the basic application characteristic of a Sylphon Bellows. It shows just how a bellows converts pressure and temperature changes into controlled mechanical movement, and demonstrates graphically how this movement is harnessed to perform innumerable tasks.

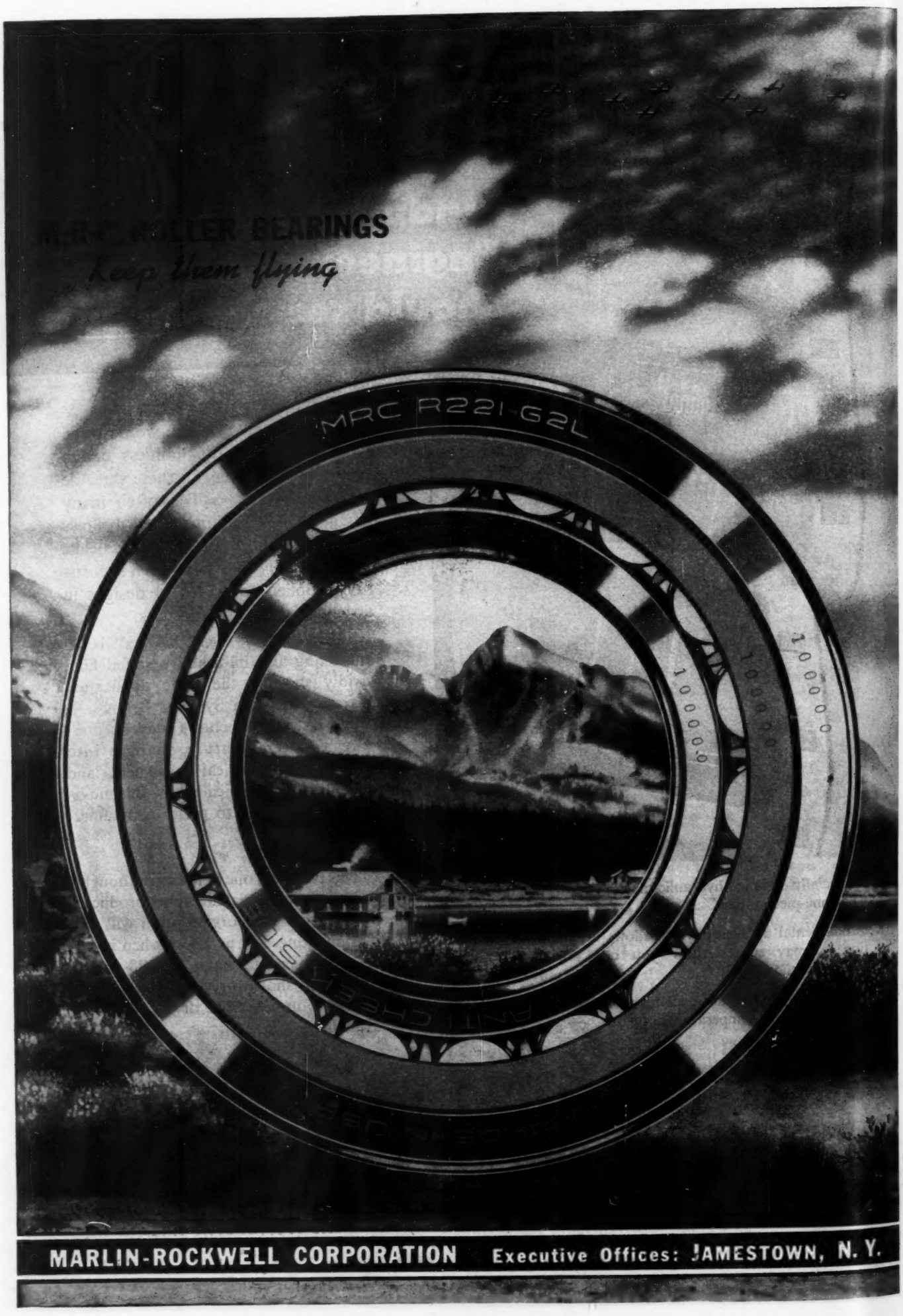
This picture is one of the most thought-provoking industrial films ever produced. We are sure your organization will find it stimulating. Let us know when it will be convenient to have this 28-minute sound film shown to your group, at no cost to you. 16 MM or 35 MM film available.

1. A specially designed hydraulic machine forms metal bellows from one-piece tubes.
2. Fundamental applications of bellows are shown in animation . . . may suggest how you can profitably employ Sylphon bellows.
3. This portion of the film explains the operating principle of various types of temperature controls.

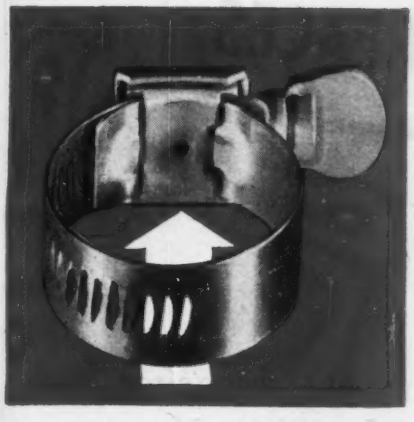
FULTON **SYLPHON**

TEMPERATURE CONTROLS — BELLOWS . . . BELOWS ASSEMBLIES

THE FULTON SYLPHON CO., KNOXVILLE 1, TENNESSEE

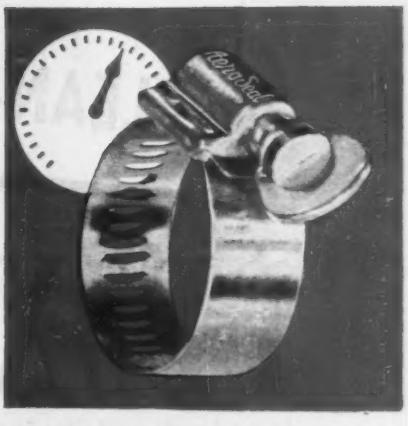

MRC ROLLER BEARINGS
Keep Them Flying
MRC R221-G2L
MARLIN-ROCKWELL CORPORATION
Executive Offices: JAMESTOWN, N. Y.

FIVE
ENGINEERING FEATURES



NON-WELDED SADDLE

CORROSION RESISTANT



GREATER BAND STRENGTH

GREATER FLEXIBILITY

LIGHTER WEIGHT

AIRCRAFT Standard PARTS CO.

AIRCRAFT Standard PARTS CO.

"Aero-Seal"
STAINLESS STEEL WORM DRIVE
HOSE CLAMPS

FIVE outstanding constructional features of "Aero-Seal" STAINLESS STEEL Hose Clamps are indicated above. The new mechanically interlocked saddle removes any doubts as to uniformity of welds at this vital point. Corrosion resistance is inherent with ALL-STAINLESS-STEEL parts. Stainless has greater tensile strength than carbon steel, producing greater band strength even though the band is thinner. The lighter, stronger stainless steel band has greater flexibility and the whole clamp is lighter in weight throughout with a gain, rather than loss, in durability and holding power. *In addition,* you get all the basic "Aero-Seal" features — smooth and powerful worm gear drive, compact housing, no loose parts, open-able band, vibration-proof holding, wide range, long take-up, uniform pressure, no distortion of thin-wall tubing, and ability to hold high pressures without leakage. Remember — *we originated* the "Aero-Seal" design and offer you the further advantage of longest experience in the manufacture of this new and better type of hose clamp.

AIRCRAFT STANDARD PARTS CO.

1713 NINETEENTH AVE., ROCKFORD, ILLINOIS

Durable Paint Coats Require CLEAN-CONDITIONED SURFACES

DEOXIDINES *have long been recognized as ideal metal cleaners, their unusual merits as perfect conditioners have often been overlooked.*

There is a grade of Deoxidine to meet your specifications for cleaning and conditioning.

The efficiency of Deoxidine is already well established: if you have not tried Deoxidine, the speed, economy, simplicity and effectiveness of its processes are easily demonstrated in your own plant and under your own working conditions.

AVOID PAINT FAILURES— Deoxidine cleans all metals, except zinc and cadmium, completely and destroys visible or invisible chemicals which, if permitted to remain, would cause premature paint failures—at the same time minutely etching and conditioning the surface, thus providing a most satisfactory bond for paint coats. In addition to properly preparing aluminum for painting, Deoxidine cleans it most acceptably in preparation for "Alrok"* coatings.

DEOXIDINES FOR VARIED USES— There are types of Deoxidine for application with brushes, by immersion in suitable tanks or by spraying in power washers. Grades also of each of these types that adapt them to the removal of much or little rust and oil. There are processes worked out for the use of Deoxidine in large or small production and for big or little work.

The experience of ACP Laboratories and Technicians is at your service to advise the Deoxidine best suited to your needs.

* Reg. T. M. Aluminum Co. of Am.

Manufacturers of Inhibitors & Metal Working Chemicals

CHEMICALS ACP PROCESSES

AMERICAN CHEMICAL PAINT CO.
AMBLER ACP **PENNA.**

CHEMICALS ACP PROCESSES

Note: West Coast Plants may address inquiries and orders for prompt delivery to: Leon Finch, Ltd., 728 East 59th St., Los Angeles, Calif.

American Chemical Paint Company, Ambler, Pa.
Please send me general Technical Service Data Sheets on
☐ Peroline ☐ Deoxidine
*Name*_____ *Title*_____
*Company*_____
*Address*_____
G-7

LOOK to the FUTURE with CLEAR VISION

WE LOOK AHEAD to a nation of fliers. Our youth will serve, as they always have, to keep America in the forefront of world aviation. Son will teach Dad.

With this growth, *Safety* will be a vital requirement. To see the runways, to be sure of the take-off and the landing, to enjoy clear vision while cruising, Marquette Windshield Wipers will help greatly toward safe flying and provide comfort to the pilot during inclement weather.

Many different models of Marquette Wipers are used on the aircraft of our Airlines, our Army Air Forces, and our Navy Air Forces.

Marquette wipers for future aircraft, including the planes of the private flyer, will be based on this experience.

FOR EXCELLENCE

The Marquette METAL PRODUCTS CO.

CLEVELAND 10, OHIO

Manufacturers of: HYDRAULIC AND ELECTRIC WINDSHIELD WIPERS FOR AIRCRAFT
HYDRAULIC GOVERNORS FOR DIESEL ENGINES • ROLLER BEARING TEXTILE SPINDLES • FUEL OIL PUMPS
AIR COMPRESSORS • PRECISION PARTS AND ASSEMBLIES

DON'T LET TANGLED HOSE
REDUCE SAFETY AND EFFICIENCY

PLAY SAFE!

Specify

AIRCO-TWIN

THE MODERN "2 IN 1" HOSE FOR WELDING AND CUTTING

INCREASE the safety and efficiency of your welding and cutting operations by using Airco-Twin Hose. This modern hose is actually two separate lines molded into a single flexible unit.

Airco-Twin Hose is strong and will withstand pressures many times greater than those required for welding and cutting operations. For easy identification in coupling, the acetylene line is red and the oxygen line is black.

OPERATORS PREFER AIRCO-TWIN HOSE BECAUSE.

(1) It does not kink as do individual lines of hose.

(2) It can easily be shifted about—less chance of entangling with other objects.

(3) Compact—it is easier to keep out of the way of hot slag and sparks.

(4) Saves time required to tape up individual hose lengths.

A further description of Airco-Twin Hose is available in our folder ADC 609-A. It can be obtained from the nearest Airco office, or if you prefer, address your inquiry to Department A, at the New York office.

★ BUY UNITED STATES WAR BONDS ★

AIRCO

AIR REDUCTION

General Offices: 60 EAST 42nd STREET, NEW YORK 17, N. Y.
In Texas: MAGNOLIA AIRCO GAS PRODUCTS CO. • General Offices: HOUSTON 1, TEXAS
Offices in all Principal Cities

Aerostands

Put the crewmen in position to work more efficiently and save the needless effort expended in moving a variety of fixed equipment around the airplane. They are easily towed to any working location on the airport and are BUILT TO TAKE IT.

PENNSYLVANIA-CENTRAL AIRLINES

WASHINGTON NATIONAL AIRPORT • WASHINGTON 25 • DISTRICT OF COLUMBIA

October 18, 1944

Mr. Carl E. Swift
Pacific Engineering Corp.
3123 San Fernando Road
Los Angeles, 41, California

Dear Mr. Swift:

We are using your Model 10 Aerostands in our Airplane Maintenance and Overhaul activities and have found that they are unusually flexible and capable of fulfilling many more requirements than our fixed equipment.

They are easily moved around the hangar or towed behind a tug to any place around the airport which further increases adaptability and permits them to perform many functions that would normally require makeshift arrangements. This flexibility saves much time and effort on the part of our personnel.

Further, since they can be raised and lowered through such a large range, they can be moved into position and adjusted to the exact requirements of the job to be performed and lowered for maneuvering beneath wings and other low surfaces. They can then be raised to position with a minimum of effort at the new location.

The guard rails and operating characteristics insure safe operation, which is very important. New accessories now being developed will undoubtedly increase their value still further and there is no question but that many more of these units will be used in our future operation throughout our system.

Very truly yours,

J. Vierling
Chief Engineer

Scientifically Simple

SKYWAY TO THE VICTORY CITIES

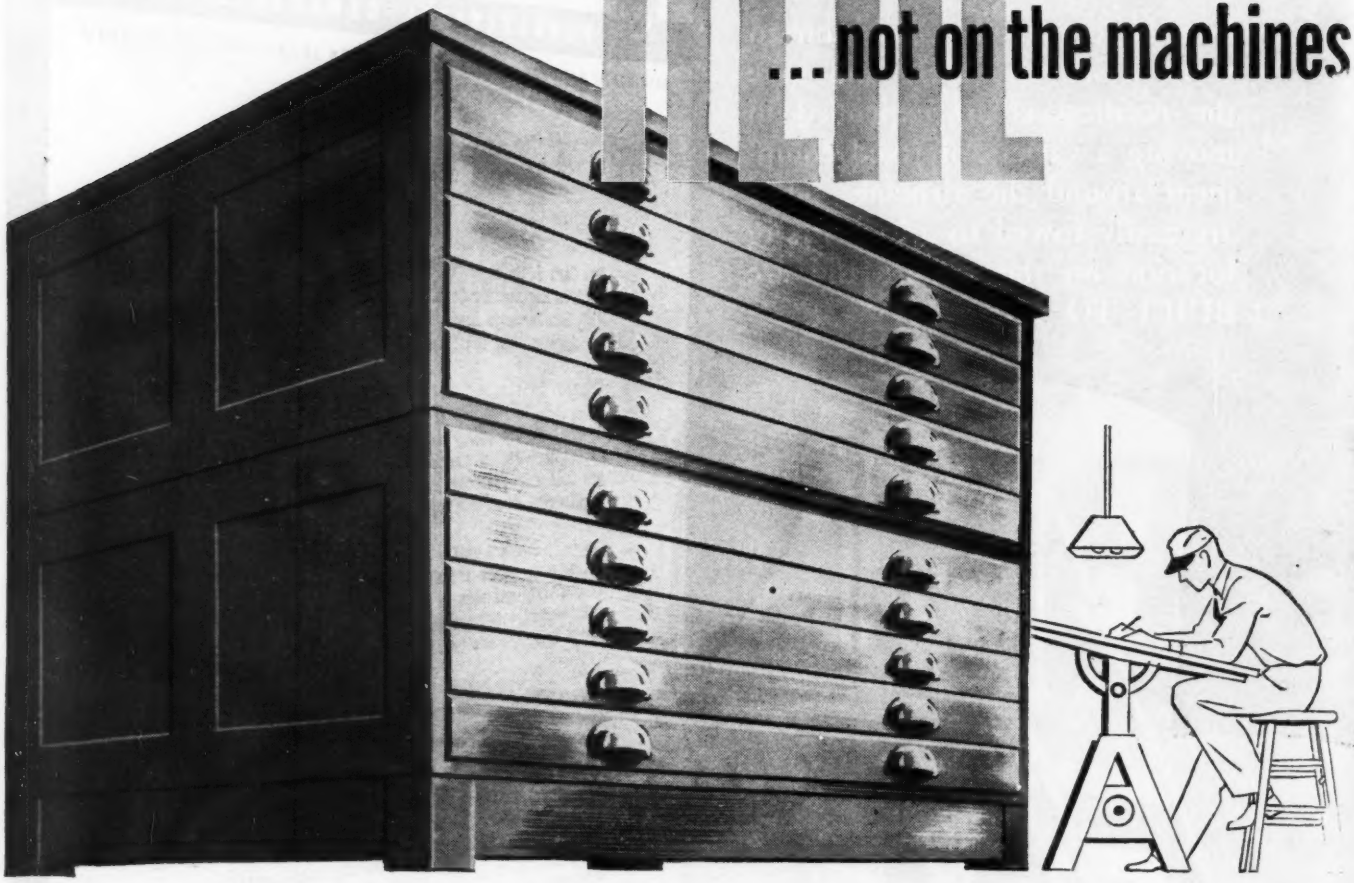
MODEL 10 AEROSTAND — *Write for Information on Other Models*

PACIFIC ENGINEERING CORPORATION

DESIGNERS AND PRODUCERS OF SPECIAL EQUIPMENT

3123 San Fernando Road • Los Angeles 41, California • Telephone Albany 1191

Your originals belong HERE ...not on the machines



PENCIL originals are precious, but even when they are new they often give unsatisfactory shop prints. When they are handled, they wear and blur. Prints made from them get cloudier still.

So use your pencil originals only once—to make PHOTACT Prints with *ink-intense* lines on PHOTACT Tracing Paper or Cloth.

Then make all the blueprints, blue or blackline prints or brownprint negatives you need from your PHOTACT Prints. They will be more legible than any made from the average pencil original.

For full information, write on your letterhead to PHOTACT Department, Keuffel & Esser Co., Hoboken, N. J.

PHOTACT

Reg. U. S. Pat. Off.

REPRODUCTION PAPERS AND CLOTHS

K+E

TRADE MARK

KEUFFEL & ESSER CO.

ESTABLISHED 1867

Drafting, Reproduction, Surveying Equipment and Materials. Slide Rules. Measuring Tapes.

CHICAGO • DETROIT • ST. LOUIS • NEW YORK • HOBOKEN • SAN FRANCISCO • LOS ANGELES • MONTREAL

he knows how to use air—do you?

By effectively using natural air the paratrooper skillfully controls his speed and direction of descent. Compressed air, effectively used and properly controlled, does many tedious jobs for industry, saving time, labor and life or limb.

Air power is efficiently and safely handled with Schrader Air Control Products, a comprehensive line of modern air devices. Some of these products simply enable you to use air efficiently and conveniently, others boost production by eliminating slow operations. Still others reduce operator fatigue, or increase the safety of skilled fingers.

Whatever types of machines you are now operating, whatever you now make or plan to make after the war, you may be rewarded out of all proportion to cost by adding the power and versatility of air to new or war-worn machines.

For a specific example of the application of Schrader Air Control Products, look into the advantages of Schrader Hand-Operated Safety Control Sets, Foot-Operated Machine Control Sets, and Kick Press Control Sets. See your distributor or write to Schrader, Dept. H.

PROTECT SKILLED HANDS with Schrader Hand-Operated Safety Control Sets. The compressed air operates the machine while operator's hands are kept at safe distance from the danger zone. Increase production by reducing fear and fatigue. Adaptable to most presses and machines at a very moderate cost.

100th ANNIVERSARY · 1844 · 1944

Air Valves 2, 3, 4-way • Air Operated Machine Controls
Air Operated Safety Controls • Quick Acting Couplers
Blow Guns • Air Ejection Sets • Hydraulic Gauges

MADE BY THE MAKERS OF SCHRADER TIRE VALVES AND TIRE GAUGES

Schrader
REG. U.S. PAT. OFF.
CONTROLS THE AIR

A. SCHRADER'S SON, *Division of Scovill Manufacturing Company, Incorporated,* **BROOKLYN 17, NEW YORK**

OK'D BY X-RAY

Over every theater of war, skies are virtually darkened by overwhelming numbers of Allied fighters and bombers—tons of winged destruction attaining meteorlike speeds. In this air superiority lies the victory factor.

To determine absolute fitness of each vital part that goes into these fighting planes—insure stamina equal to the gruelling punishment they undergo—U. S. aircraft manufacturers depend on x-ray. Fast, accurate, and nondestructive—x-ray inspection provides visual evidence which can be correlated with physical tests—information of immeasurable value to aircraft designers and engineers. OK'd by X-Ray means that every essential casting and weldment is completely free of sub-surface defects—assures the world's best flying men the world's best fighting aircraft.

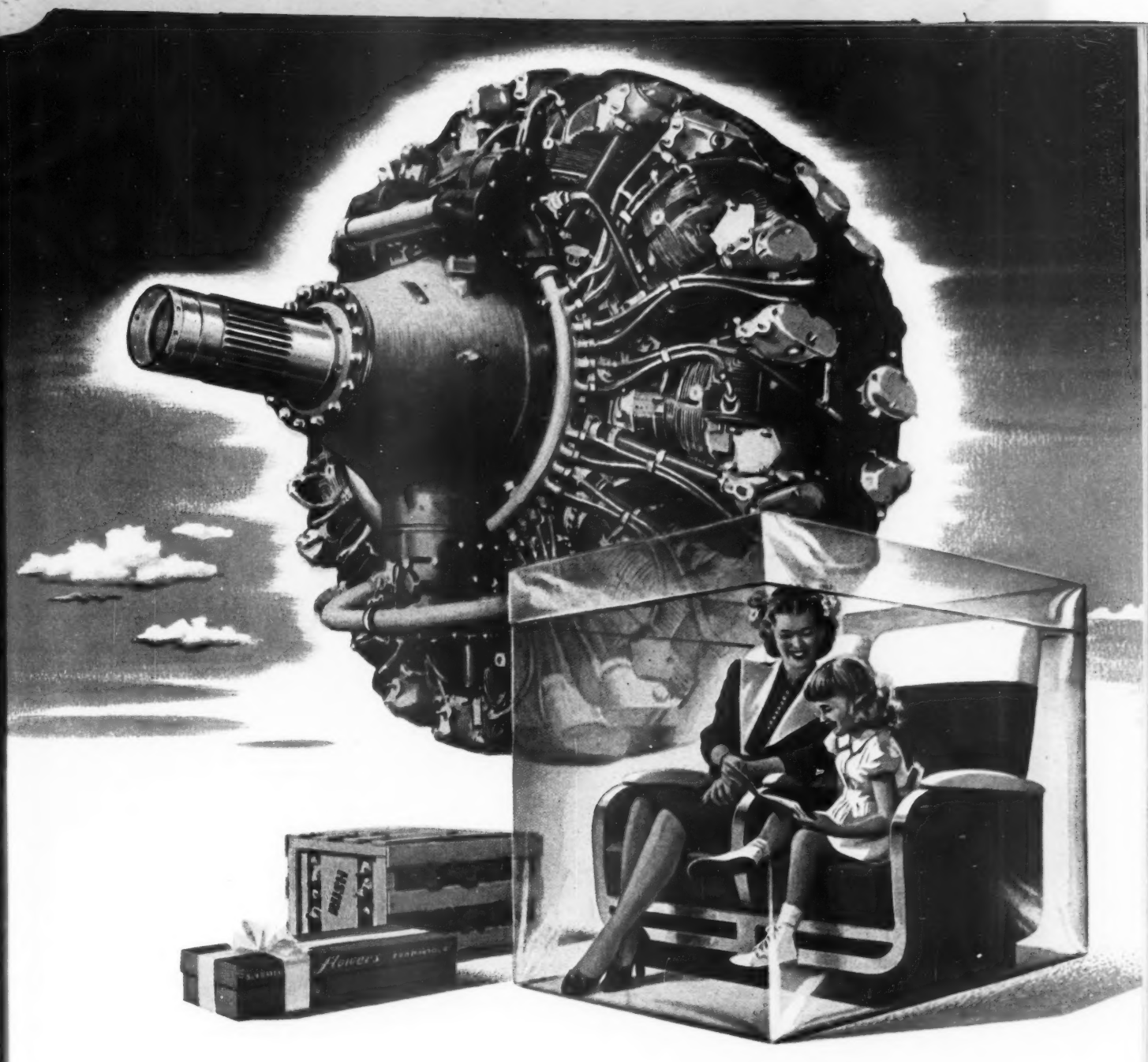
A complete line of G-E Industrial X-Ray Units is available—types to meet every aircraft inspection requirement. For complete information as to which unit is best suited to your needs, write or wire, today, to Department N812.

Inspection of propeller blades with a G-E Industrial X-Ray Unit enabled one plant to reduce inspection personnel almost 50%—releasing essential workers for other vital jobs within the plant.

Today's Best Buy *U.S. War Bonds*

GENERAL ELECTRIC X-RAY CORPORATION

2012 JACKSON BLVD. CHICAGO (12), ILL., U. S. A.



Faster and Fresher via Cyclones

Transportation of perishables by air becomes a highly interesting prospect as ton-mile costs shrink. Yet no commodity under consideration is so perishable as human vitality, which on extended trips wilts like lettuce or gardenias.

Faster, Cyclone-powered air transport gives passengers a wide travel advantage in distance covered before fatigue sets in. With still higher standards of commercial speed in sight for tomorrow, transportation to any part of the world will be possible with maximum saving of passenger vitality.

The accepted high-power engine for super-speed transport in such installations as the Boeing Superfortress, Lockheed Constellation, Curtiss CW-20E Commando and Martin Mars is the Cyclone 18, with a rating of more than 2200 horsepower. True to Wright tradition, the smooth-running Cyclone 18 is thrifty of fuel and maintenance, and offers operators a payload bonus of two extra passengers over comparable power plants. *Wright Cyclones pay their way.*

WRIGHT POWERS THE TONNAGE OF THE AIR

Cyclones Save 3 Ways

LESS WEIGHT—MORE PAYLOAD
LOWER FUEL CONSUMPTION
REDUCED MAINTENANCE

WRIGHT

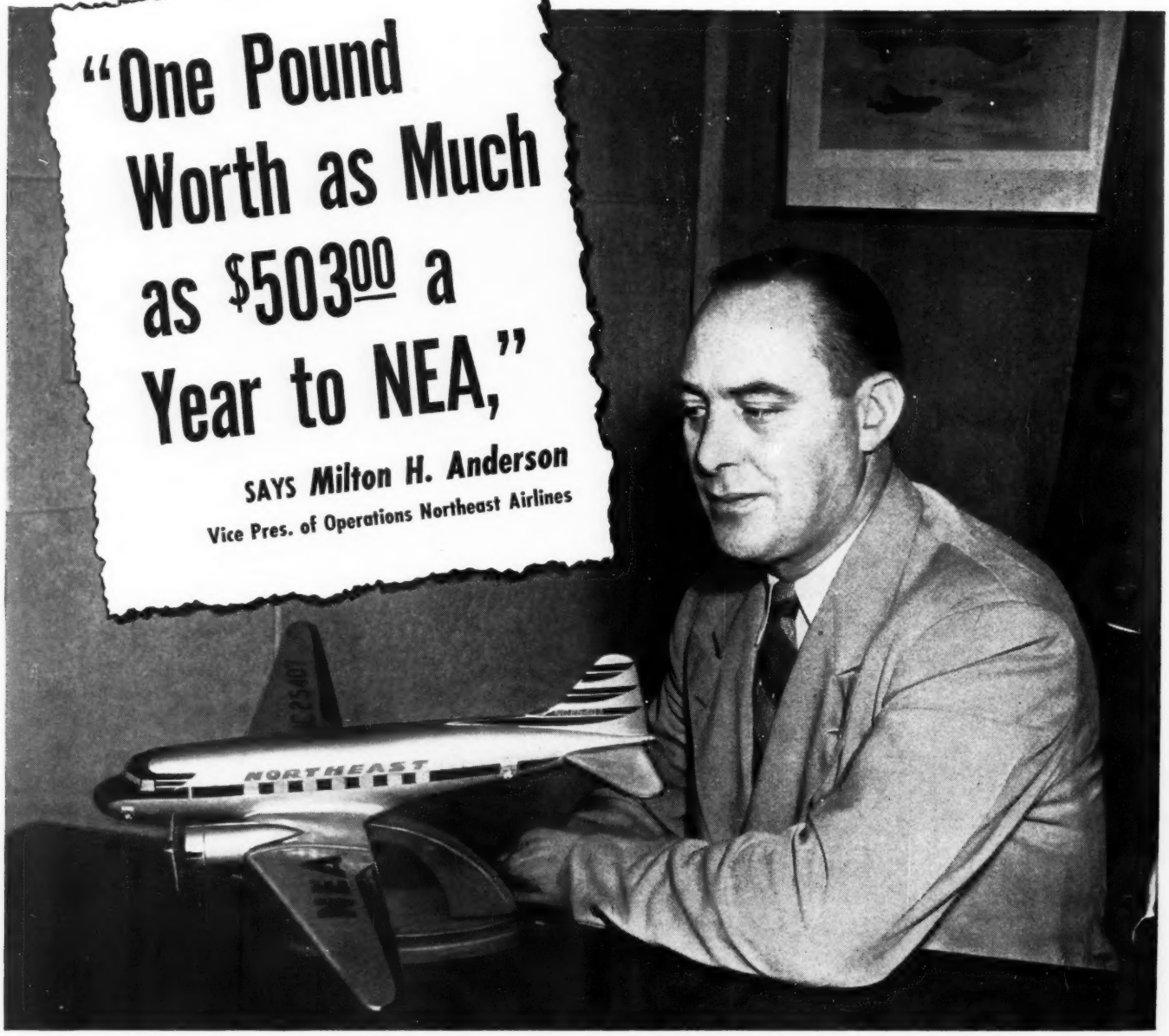
Aircraft Engines

Wright Aeronautical Corporation
A Division of Curtiss-Wright Corporation
Paterson, New Jersey, U.S.A.

"One Pound Worth as Much as $503.00 a Year to NEA,"

SAYS Milton H. Anderson

Vice Pres. of Operations Northeast Airlines



"Our experience in New England over a period of years emphasizes the value of every pound of increased pay load. Each pound of unnecessary weight saved can mean that much more for passengers and cargo. For example, one pound of excess weight on the Boston-New York run, operated with 24-passenger DC-3's on hourly schedules, could cost Northeast as much as $503.00 a year."

Boots Nuts Save Up to 60 Lbs. Per Plane

- Lighter, tougher, Boots step up cargo capacity.
- Meet all specifications of government aviation agencies.
- Standard fastenings on all post-war commercial ships.
- Wartime standard nuts on all types of planes—fighters, bombers, transports.
- Can be used again and again—yet self-locking grip never slips.
- "Outlast the plane."

Motion Picture—"All Work And NoPlay"—16 mm. sound—30 minutes. Write for information.

BOOTS STEEL ANCHOR NUT

(W2S #8-32) The comparable fibre nut is 151.2% heavier than this all-metal, steel self-locking nut.

Send for Free Weight-Saving Booklet

Actual weights of over 250 different self-locking nuts used in aireraft, comprehensively reviewed for the convenience of aireraft designers, engineers, operating and maintenance personnel. Copy will be sent you, free, on request.

BOOTS SELF-LOCKING NUTS

"They Fly With Their Boots On—Lighter"

Boots Aircraft Nut Corporation, General Offices, New Canaan, Conn., Dept. I

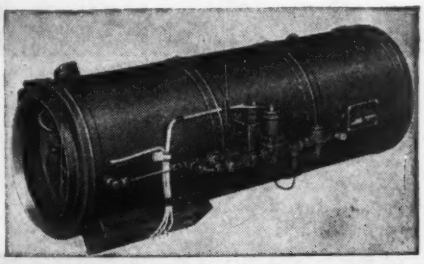
Representatives in New York • Chicago • Detroit • Indianapolis • Los Angeles • Kansas City • Dallas • Toronto • Montreal • Vancouver

Another fluid heat Aircraft Heating Achievement . . .

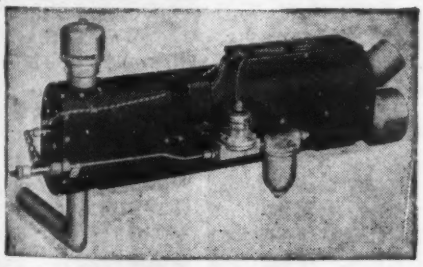
The Lightest 15,000 BTU Heater on the Market!

6 lbs. 14 oz.
complete with all controls and accessories!

Fluid Heat's Model SRH-15 Heater. *(at right)*
Though it weighs only 6 pounds, 14 ounces, *complete with all controls and accessories*, this heater has a maximum output of 15,000 BTU in flight. Dimensions are 4⅝ inches by 18¾ inches. As for all models, blower is available for ground operation.



Fluid Heat's Model SRH-100. Output: 100,000 BTU per hour; weight only 24½ pounds. Diameter is 9 inches, length 27 inches. Model SRH-50, delivers 50,000 BTU, weighs but 16 pounds, 10 ounces; measures 6½ inches by 20 inches. Weights include all controls and accessories. Blowers available for ground operation, with transfer between flight and ground phase automatic.



Fluid Heat's Model STH-15. Proportionately light-weight and compact, this model delivers 15,000 BTU per hour. All controls and accessories included, it weighs only 8 pounds. Dimensions are 3 inches by 5 inches by 18 inches. Used to defrost windshields and heat fighter-plane cockpits.

THOUGH it delivers 15,000 BTU per hour under flight conditions, Fluid Heat's Model SRH-15 Aircraft Heater weighs only 6 pounds, 14 ounces, *complete with all controls and accessories.* Ideal for single and two-place airplanes. Blower is available for ground operation. Transfer between ground and flight phase is automatic, assuring continuous service.

Built around a new heating principle of special advantage in aircraft heating, this super-light heater employs a vapor-entraining process utilizing pre-heated combustion air. The process accomplishes combustion with an unusually low pressure drop, permitting operation at low ram pressures. It produces a completely suspended fire and therefore gives freedom from lead oxide formation. Flame retention is so positive that flame characteristics are the same from sea level to ceiling. Automatic compensation assures high combustion efficiency at all air speeds.

The same characteristics and outstanding lightness feature all models of Fluid Heat's complete line of aircraft heaters.

The 100,000 BTU unit, for instance, weighs but 24½ pounds. The 50,000 BTU unit weighs only 16 pounds, 10 ounces. *These weights include all controls and accessories.*

Fluid Heat has, for sixteen years, led in the development and manufacture of automatic combustion and heat transfer equipment. Those years of heat engineering know-how are built into each light, compact, efficient Fluid Heat Aircraft Heater. You will want Fluid Heat Aircraft Heaters on planes you design, build or equip. Write for full information on this new heating achievement.

FLUID HEAT DIVISION
Anchor Post Fence Co.
6750 Eastern Ave., Baltimore 24, Md.

fluid heat
AIRCRAFT HEATERS

EASIER, FASTER, LOWER-COST TOOLING WITH FIBERGLAS*-REINFORCED PLASTICS

The combination of Fiberglas and specially developed, low-pressure resins has resulted in a material with many unique and mechanically important characteristics. Lightness, rigidity, dimensional stability, high impact strength and ease of fabrication are among the advantages particularly significant in the production of Fiberglas-reinforced plastic dies, jigs and fixtures.

The high cost of manufacturing metal dies is eliminated. Costly, time-consuming machining is avoided.

FABRICATING FIBERGLAS-REINFORCED PLASTICS

One of the techniques developed, by Douglas Aircraft engineers, for the fabrication of Fiberglas-reinforced plastic jigs is illustrated at the right:

No. 1. The male mold (or, if available, the actual part), backed with plaster of Paris, is placed on a corrugated metal table equipped with air valve for producing vacuum.

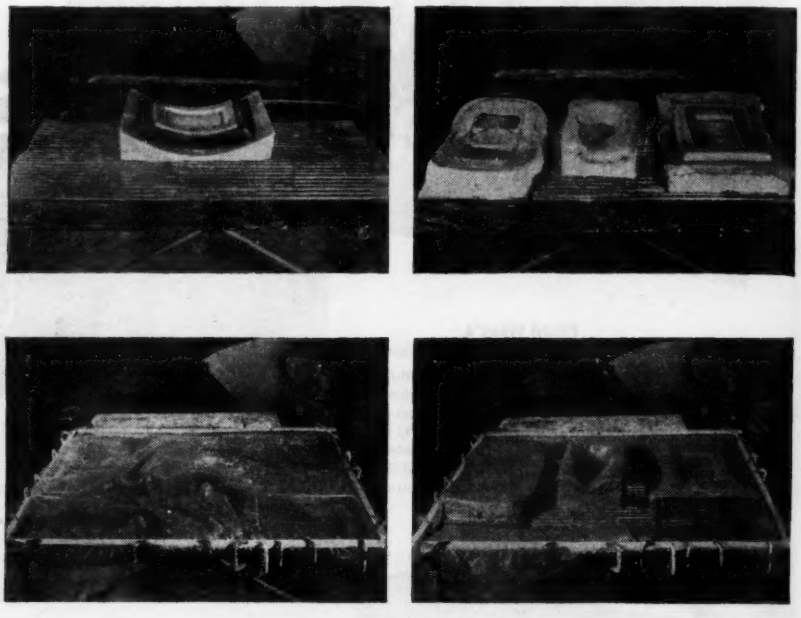
No. 2. The form block is covered with cellophane to prevent resin from sticking to the mold. Then the Fiberglas cloth laminations are trimmed to fit the form block . . . the low-pressure resin is rubbed into the cloth and the desired number of layers are built upon the form block.

No. 3. A rubber blanket is stretched over the mold.

No. 4. Air is evacuated. As the pressure is increased excess resin and air pockets are squeezed out of the laminates. The table is then rolled into the oven to complete polymerization of the resin at about 180° F.

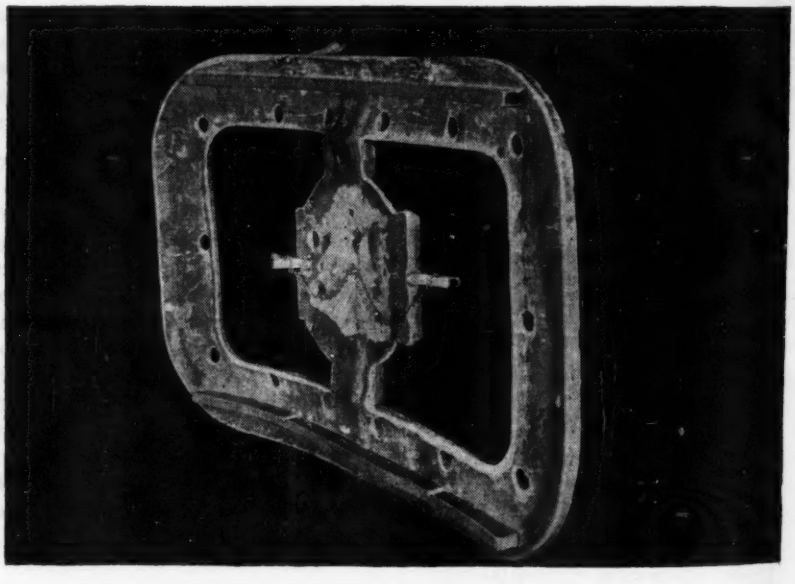
No. 5. After curing and cooling, the form block is removed, flanges are trimmed, holes drilled, clamps installed to complete the tool.

All available fabricating data and additional information about Fiberglas products and Fiberglas-reinforced plastics will be furnished on request. Write: *Owens-Corning Fiberglas Corporation, 1891 Nicholas Building, Toledo 1, Ohio. In Canada, Fiberglas Canada Ltd., Oshawa, Ontario.*



Steps in the production of a jig for spot-welding airplane doors. Fiberglas-reinforced plastics are dimensionally stable, have extremely high impact strength and are nonconductive of electricity.

Photos courtesy: Douglas Aircraft Co., Inc.



ARMY E NAVY

FIBERGLAS.. *A BASIC MATERIAL*

*T. M. Reg. U. S. Pat. Off.

YOU see, that's our business . . . building things . . . all sorts of things.

Jones & Lamson is the oldest machine tool company in America and there is literally no industry (and few important products) to which Jones & Lamson engineering has not contributed, both in war and in peacetime production.

So you dream it . . . we'll help build it.

We'll draw up complete production specifications. We'll engineer the tooling. We'll specify, design, and create any special machine tools needed. We'll even plan the plant and its equipment.

You dream it.

We'll help build it . . . from the ground up, if need be.

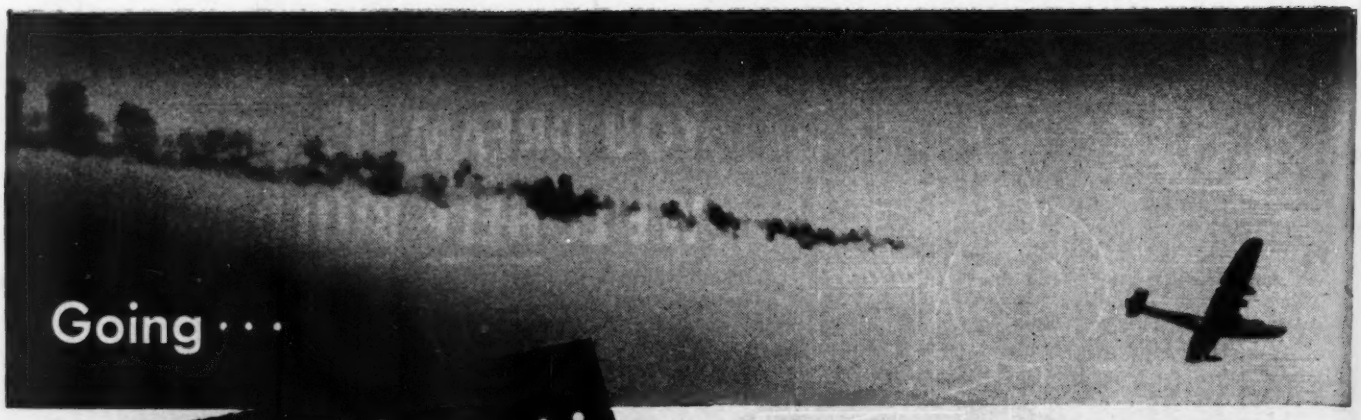
These engineering facilities will become available to you as soon as conditions permit. Meanwhile, we solicit your inquiries.

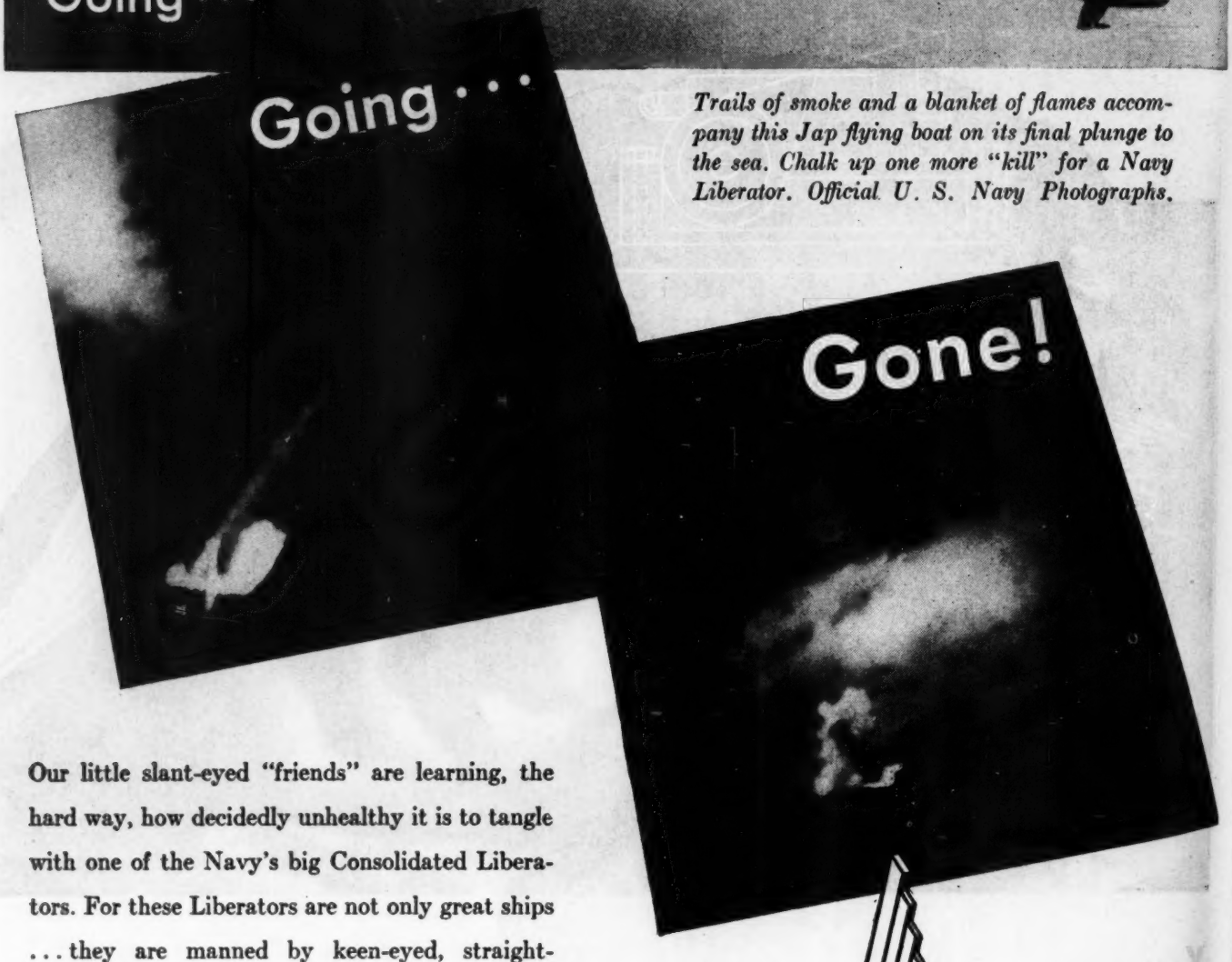
JONES & LAMSON

MACHINE COMPANY

Springfield, Vermont, U.S.A.

Manufacturers of: Universal Turret Lathes • Fay Automatic Lathes • Automatic Double-End Milling and Centering Machines • Automatic Thread Grinders • Optical Comparators • Automatic Opening Threading Dies and Chasers.





Trails of smoke and a blanket of flames accompany this Jap flying boat on its final plunge to the sea. Chalk up one more "kill" for a Navy Liberator. Official U. S. Navy Photographs.

Our little slant-eyed "friends" are learning, the hard way, how decidedly unhealthy it is to tangle with one of the Navy's big Consolidated Liberators. For these Liberators are not only great ships . . . they are manned by keen-eyed, straight-shooting, "hell-for-leather" American boys who like nothing better than to get a Nip flying boat, such as the one pictured here, in their sights.

It is gratifying to us here at CECO to know that CECO carburetors and fuel pumps on these newest great Liberators are doing their part in helping our fighting men beat a path to Tokyo. And we pray that the day is not too far distant when once again CECO products will be earmarked for airships rolling off peacetime assembly lines.

CECO

CARBURETORS
FUEL PUMPS
PROTEK-PLUGS

CHANDLER-EVANS CORPORATION SOUTH MERIDEN CONNECTICUT, U. S. A.

THIS BIG FAMILY OF

Intelin

High Frequency Cables

MEASURES TO EVERY HIGH STANDARD

A big family — 29 types of high frequency cable — yet so high are their standards of construction and performance that every one of the following Intelin High Frequency Cables meets all the requirements of the most exacting specifications:

1. **Coaxial, Solid-dielectric, Semi-flexible Lines: *RG-5/U, 6/U, 8/U, 9/U, 10/U, 11/U, 12/U, 13/U, 14/U, 15/U, 17/U, 18/U, 19/U, 20/U, 29A/U, 54/U, 54A/U, 58/U, 59/U.**
2. **Coaxial, Air-spaced, Low Capacitance Lines: 7/U, 62/U, 63/U.**
3. **Coaxial, Attenuating Lines: RG-21/U, 42/U.**
4. **Coaxial, High Impedance, Spiral Delay Line: RG-65/U.**
5. **Dual (balanced) Lines: RG-22/U, 57/U.**
6. **Dual-coaxial, Highly Balanced Lines: RG-23/U, 24/U.**

*Type number designations are those of the Army-Navy R. F. Cable Coordinating Committee.

To date, for every new high frequency cable need, Intelin has developed and produced the answer. Whatever your requirements in high frequency cable, consult Federal first.

Federal Telephone and Radio Corporation

AN IT&T ASSOCIATE

Newark 1, N. J.

Confidence-inspiring *strength*

in fasteners for ships of the air—

★ **CLEVELAND AIRCRAFT BOLTS**

You may be sure that Cleveland Aircraft Bolts are made strictly to AN specifications—as to steel analysis, dimensions, threading, drilling. *Added*, at no extra cost, is extra strength through manufacture by the Kaufman Process—our own plant development which assures proper grain flow characteristics needed for unusual stress requirements. Write for prices and discounts.

CLEVELAND *Top Quality* **FASTENERS**

The Cleveland Cap Screw Company

2945 EAST 79TH STREET • CLEVELAND 4, OHIO

ALLOY AND AIRCRAFT PARTS DIVISION

MADE BY THE ORIGINATORS OF THE KAUFMAN PROCESS FOR GREATER STRENGTH AND ACCURACY

We are glad to announce that VARD INC. is now manufacturing electrically powered, mechanical actuators for aircraft.

This addition completes our line, as we have built hydraulic cylinders, valves, switches and fluid actuators for several years.

We are able with the facilities of our own foundries, machine shops, thread grinding, gear generating, honing and plating departments to produce these mechanical actuators almost in toto. Steel tubing, screws, wire, bearings and motors are the parts we do not make.

VARD facilities are always available to help design and build your special aircraft requirements.

MECHANICAL ACTUATORS

Now Manufactured by...

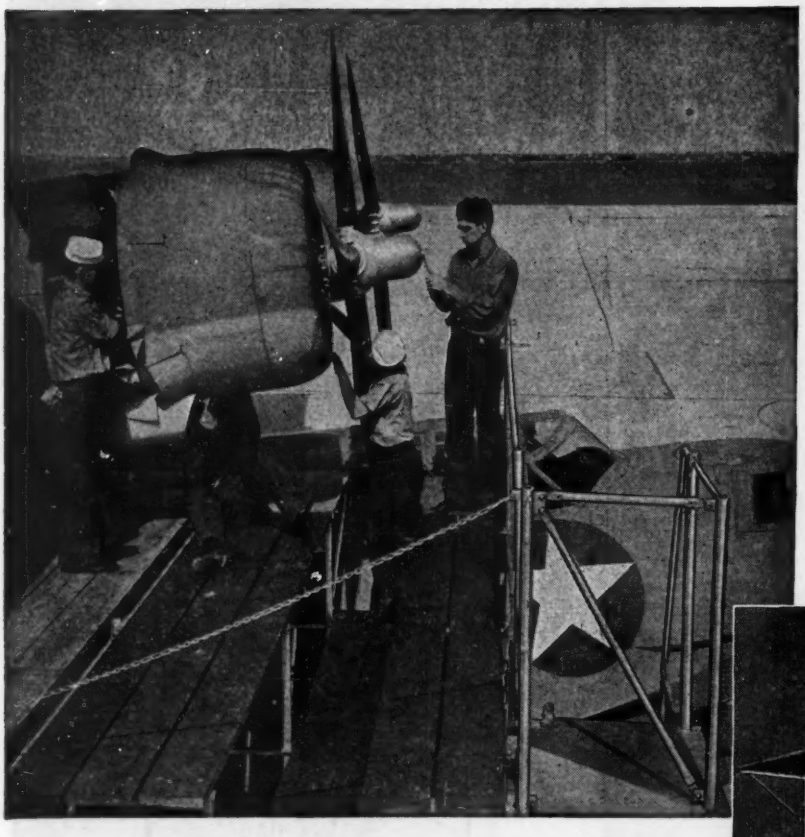
VARD INC.

PASADENA 8, CALIF.

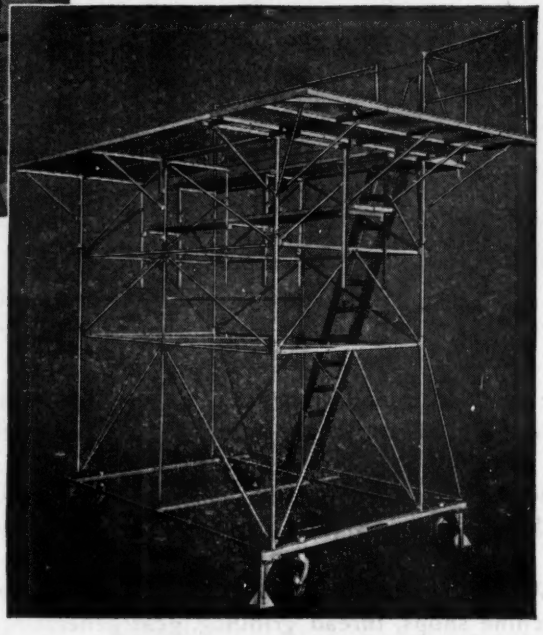
A BIG STAND FOR BIG JOBS

AIREPAIR
(SERIES 9 STAND)

High as a Dirigible--Low as a Trainer--For One or a Dozen Mechanics



How can a mechanic be expected to do careful, accurate service and repair jobs standing on boxes and oil drums or rickety home-made stands? The Airepair line of factory-made stands are engineered and built especially for aircraft repair. Roomy, rigid, and portable, they are more serviceable than a "ladder" and require no maintenance. Heavy engine parts can be repaired right on the platform. The prop well permits checking and timing valves without the necessity of pulling the engine. More Airepair Series 9 Stands are now used for servicing the larger type planes than any other stand. Airepair is truly a generous stand for Big Jobs.



With the addition of 3 foot intermediate sections the Series 9 Airepair platform height can be increased to 25 feet—high enough to service a blimp or a dirigible.

Wolfe & Mann

MANUFACTURING COMPANY

AIRCRAFT EQUIPMENT DIVISION

28TH AND SISSON STS. ★ BALTIMORE · 11 · MD.

Fuel Tanks of Navy "Coronado" Patrol Bombers

Sealed with PRESSTITE SEALING COMPOUNDS

Many a tale has been told of the great work being accomplished by the Navy's PB2Y's—known as "Coronado" Patrol Bombers—in jobs ranging from bombing missions to heroic surface rescues. The fuel tanks of the Navy transport version of this type of plane, designated PB2Y-3R, are resealed by the Rohr Aircraft Corp. of Chula Vista, California.

Integral Fuel Tanks in these giant ships, the largest mass-produced plane in Navy service, are sealed with Presstite sealing materials using the Rohr Tank Seal Process. This method of sealing integral tanks, developed by Rohr Aircraft Corp., using these proven Presstite materials, represents the latest development in sealing tanks in large transport, cargo, and similar type planes.

Meeting the complex sealing requirements of the aircraft industry is only one example of Presstite's ability to originate and develop sealing compounds for specific requirements.

If your product or your manufacturing processes call for sealing or coating compounds, send your requirements to sealing specialists. We'll gladly work with you and your engineers in suggesting the most effective compounds to fit your needs.

PRESSTITE SEALING COMPOUNDS

PRESSTITE ENGINEERING COMPANY, 3910 Cheuteau Avenue, St. Louis 10, Missouri

A Partial List of Industries for Which Presstite has successfully Developed Special Sealing Compounds:

For the Aircraft Industry:
Sealers for
- Integral Fuel Tanks
- Fuselage Seams
- Drop-off, Expendable Fuel Tanks
- Gun Turrets
- Synthetic Glass
- Instruments
- Intercoolers
- Air Ducts
- Insulating Dissimilar Metals
- Seaplane Floats

For the Refrigeration Industry:
Sealers for Domestic and Commercial Refrigerators
Bonding and Sealing Low Temperature Insulation in Refrigerated Rooms

For the Railroads:
Sealers for Insulating, Soundproofing and Weatherproofing of Railway Cars—Sealing Car Windows and Spot Welded Seams

For the Building Industry:
Roof Coatings, Caulking, and Waterproofing Compounds

For the Shipbuilding Industry:
Insulation Adhesive and Sealers — Rust Preventive Compounds

For the Automotive Industry:
Special Adhesives and Sealers

For the Construction Industry:
Sealers for Jointing Sewer Pipes
Sealers for Waterproofing Excavation Work

Miscellaneous:
For Glazing Greenhouse Windows
Extruded Caulking Compounds
Ammunition Paints
Plus Many Special Products for the Army and Navy

Our Engineering, Technical, and Laboratory facilities are at the service of any industry with a sealing problem.

Keep Your Production Machines in Line... LIKE BOMBERS RUNNING OVER THEIR TARGET

...keep them under VEEDER-ROOT "COUNTROL"

Daily production steers steady as a rock, straight in to its target of on-time shipments, when all machines in all production lines are kept under Veeder-Root "*Countrol.*" For "*Countrol*" is based on the facts in figures continuously supplied by Veeder-Root Devices on the performance of all machines and processes . . . figures which indicate whether capacity is being maintained, so that any needed adjustments may be made immediately.

Any aircraft or engine manufacturer can get Veeder-Root Counting Devices *now*, for electrical or mechanical operation on any machine, to speak in any language: turns, strokes, pieces, trips, lengths, volumes or any other units desired. And Veeder-Root "*Countrol*" is quick, easy, and inexpensive to install, without interrupting production. Find out how it can help *your* production to count for more than ever before.

The Counting House of Industry

VEEDER-ROOT INC.

Hartford 2, Connecticut

In Canada: Veeder-Root of Canada, Ltd., Montreal
In England: Veeder-Root Ltd. (new address on request)

FORWARD

CHICAGO GRINDING WHEELS AND MOUNTED WHEELS

● Geared to the precision demands of war, Chicago Wheels have been a potent force in smashing bottlenecks—cutting down rejects—speeding production to an all-time high.

Constantly tested, constantly improved—Chicago Wheels produce finishes so perfect they pass exacting surface analyzer tests, so accurate they can be measured in micro inches.

Production of civilian goods will demand the same precision finishing methods.

Keep pace with Chicagos, the Wheels of Progress!

CHICAGO GRINDING WHEELS

Anything up to 3" in diameter in various grains and bonds, including FV, the sensational new bond with a pedigree.

CHICAGO MOUNTED WHEELS

Shapes and abrasive formulas to take care of every job of internal or external finishing.

TRY ONE FREE!

So you'll know what they can do, we will send a test wheel. Tell us material you'd like to finish and size wheel required.

AV-12

CHICAGO WHEEL & MFG. CO.

Half a Century of Specialization has Established our Reputation as the Small Wheel People of the Abrasive Industry

1101 W. Monroe St., Dept. AV, Chicago 7, Ill.

Send Catalog. Interested in ☐ Grinding Wheels ☐ Mounted Wheels. ☐ Send Test Wheel. Size.....

Name.....

Address.....

YOU CAN PARK YOUR PLANE with this New Steerable

FOR MANY YEARS, Firestone Tires have been the standard of safety for aircraft on the ground. Now, Firestone makes another contribution to greater ground reliability—a new steerable tailwheel strut assembly for light planes. It has a solid tire *vulcanized* to a plastic hub. Sealed-in lubrication requires repacking only at major overhaul periods. Tapered roller bearings carry vertical loads in the strut and in the wheel. Needle roller bearings in both strut and wheel take side thrusts. The steering mechanism has 75% ance. Beyond the controlled steerable range, simple rudder pedal operation permits automatic free swiveling action without gunning the engine or applying brakes. Throughout the entire steerable range, steering is positive and independent of tension in the rudder control connectors. The complete assembly is light in weight and low in price and the entire assembly or wheel only can be interchanged with present original equipment units. For prices and additional data write, wire or phone Firestone Aircraft

stone
... PREPARING FOR PEACE
"ON A DIME"
Tail-Wheel
The bearings designed into this new assembly are the direct result of test experience with tailwheels made to comply with specifications of the United States Navy for carrier-based fighters. This is but one example of the quality of design and materials built into this newest Firestone Aircraft product.
☆ ☆
For the best in music, listen to the "Voice of Firestone" with Richard Crooks and Gladys Swarthout and the Firestone Symphony Orchestra conducted by Howard Barlow every Monday evening over NBC network.
Copyright, 1944, The Firestone Tire & Rubber Co.

PRECISION

CLUES to better Bearing Performance

- HIGH LOAD CAPACITY
- LIGHT WEIGHT
- SMALL SIZE
- UNIT CONSTRUCTION
- ECONOMY
- WEAR RESISTANCE
- CORRECT ALIGNMENT
- ALL TYPES— Full Range of Sizes
- PRECISION
- High Carbon Alloy Bearing Steel
- ELIMINATION OF FRICTION
- SILENCE

Another Clue to the Quality of

RBC NEEDLE BEARINGS

EXACT UNIFORMITY

Precise standards have been set up by R B C Engineers to secure strict uniformity in the manufacture of R B C Needle Bearings. These standards involve twenty-five years of bearing inventiveness as applied to design, application and production.

EVEN LOAD DISTRIBUTION

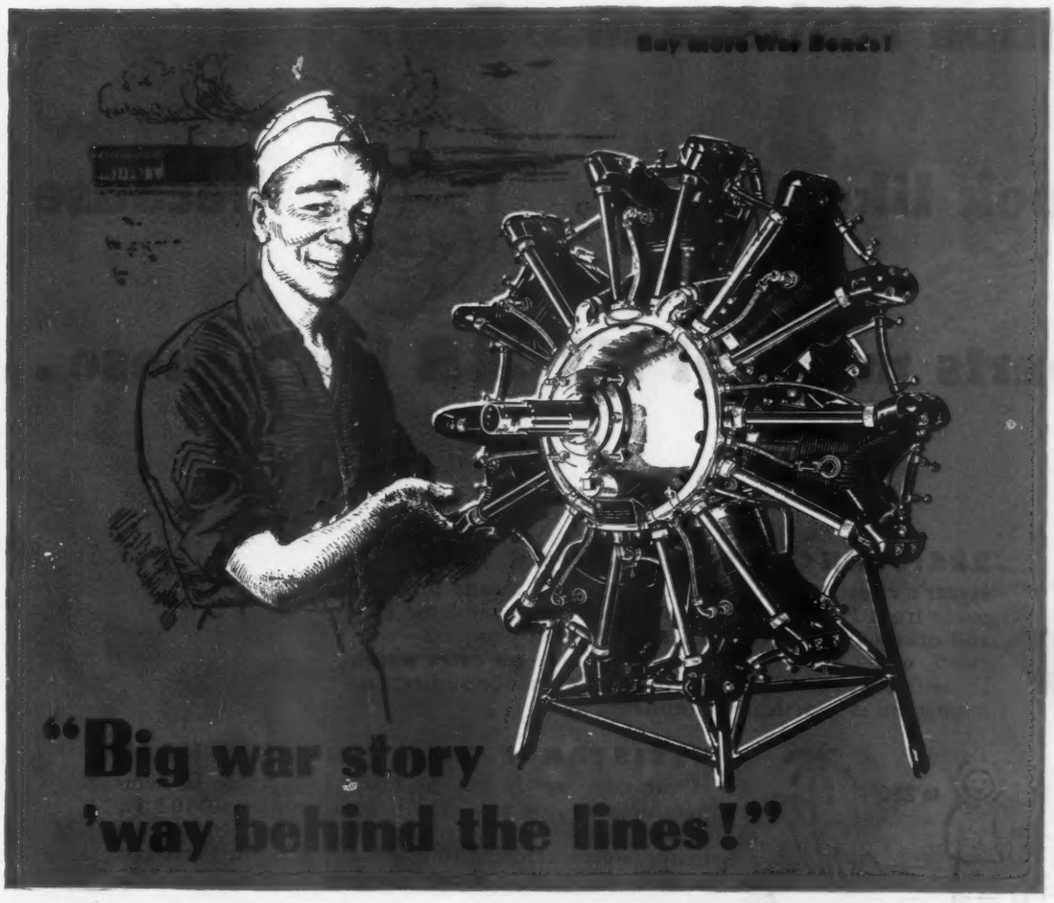
Each size group of R B C Bearings is as alike as two peas in a pod, not only in appearance, but more important in the vital load-carrying units that insure even load distribution. There can be no "lazy relations" in Aircraft, Machine Tool, Pump or Diesel Engine Bearings—each part must do its share of the work.

PUNCTILIOUS ACCURACY

R B C has many special machines and instruments manned by a large percentage of our personnel devoted to the job of inspection. This may be called "Ejecting lazy relations," but the result of this manifold police job is the R B C Bearing which is guilty only of punctilious accuracy.

R B C's ENGINEERING STAFF WILL HELP YOU IN SELECTING THE RIGHT BEARING, AND IN FOLLOWING OUT THE CORRECT BEARING PROCEDURE. LET US KNOW YOUR PROBLEMS.

ROLLER BEARING CO. OF AMERICA
TRENTON, NEW JERSEY



No matching wits with Messerschmitts, no bombing missions fraught with mischance and flak, no daring deeds that merit decoration, but a significant story in smudged service records.

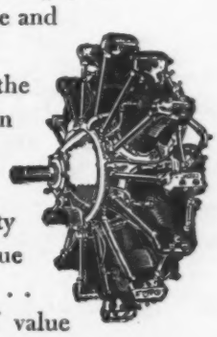
With the war under way the AAF picked the Jacobs engine for twin-engine trainers to school the bomber pilots and bombardiers.

A pre-war engine, developed during the Depression years, the Jacobs had proved itself a simple, rugged engine that stood up for long periods in all kinds of work and weather, with little maintenance. No government money went into its development. Ready for production, thousands were ordered.

FOUR years ago, the Jacobs was rated by the Army as good for 350 hours of flight time between major overhauls—long service shift for an engine handled by student pilots, taking more take-offs and more time at full throttle than engines used in any other type of flying.

As the flight hours piled up, it was found that the Jacobs was good for more than 350 hours; and the service period was extended again and again. Today, the service period of the Jacobs is as high as 1,200 hours—equivalent to 180,000 air miles of flight, not counting taxiing, and ground time.

Because it delivered more than three times the original specified service hours, the Jacobs not only speeded up training schedules, but also saved the AAF and the taxpayers millions of man-hours in shop time and maintenance.



Built to work, built to last . . . the Jacobs will mean more in peace than in war—when safety and low costs are essential to commercial flying.

The engine also certifies the ability of Jacobs to put extraordinary value into precision-built mechanisms . . . stands as a reliable guaranty of value on any product that will carry the Jacobs name plate. Watch for it, and you won't go wrong! . . . Jacobs Aircraft Engine Company, Pottstown, Pennsylvania.

JACOBS • Pottstown, Pa.

Aviation Maintenance Engineers

look like this . . .

because

parts made of HYCAR have these . . .

RESISTANCE TO GASOLINE AND OIL

Hycar's resistance to petroleum products means that parts made from Hycar—gaskets, seals, hose, accumulator bags, and others that are exposed to petroleum products—won't swell, won't absorb petroleum and take on extra weight. Dimensional stability is assured. Maintenance and replacement time is practically eliminated.

RESISTANCE TO COLD AND HEAT

Hycar compounds can be made to operate in temperatures as low as —65° F. or as high as 250° F., maintaining elasticity and resilience at the low temperatures, refusing to soften at the high. Parts last longer—little or no maintenance required.

RESISTANCE TO ABRASION

Abrasion resistance is considerably better than natural rubber and most other synthetics. Wear—and hence maintenance—is negligible, even in severe service.

RESISTANCE TO COLD FLOW OR CREEP

Even at elevated temperatures parts made from Hycar have a minimum tendency to cold flow or creep after they take permanent set from the applied loads. Hycar stays on the job—maintenance time goes down.

LIGHT WEIGHT

The specific gravity of crude Hycar is 1.00, 15% to 25% lighter than many other synthetic rubbers. Correspondingly lighter in compounded forms, Hycar parts reduce overall weight, permit more efficient operation.

THESE AND OTHER PROPERTIES OF HYCAR, such as high tensile strength and good elongation, may be had in a wide variety of combinations to meet specific service conditions. Thus the right part for the right place can be obtained. And when the part is *right,* maintenance becomes a very minor problem. If you need help in solving your individual application problems, just write our Technical Service Staff. *Hycar Chemical Company, Akron 8, Ohio.*

Hycar

Reg. U. S. Pat. Off.

LARGEST PRIVATE PRODUCER OF BUTADIENE TYPE

Synthetic Rubber

Free—write for your copy of the new pocket-size Hycar Glossary of commonly used synthetic rubber terminology.

The Greater Safety, Convenience and Economy of Post-War Aviation Must Be Planned **TODAY!**

Today's flight of the imagination will be the commonplace of tomorrow—and we at AIR COMMUNICATIONS believe that *now* is none too soon to plan for the great "Air Age" ahead. That's why AIR-COM engineers are busy adapting the science of electronics to air communications to serve aviation today *and tomorrow.*

Precision-built AIR-COM Products continue to serve America in the warplanes that are blasting open the road to victory.

The war's end will find these tested and proved AIR-COM Products — together with other AIR-COM developments — ready to assure greater *safety, convenience and economy* for all types of private planes and for the giant commercial freight and passenger transports of the air.

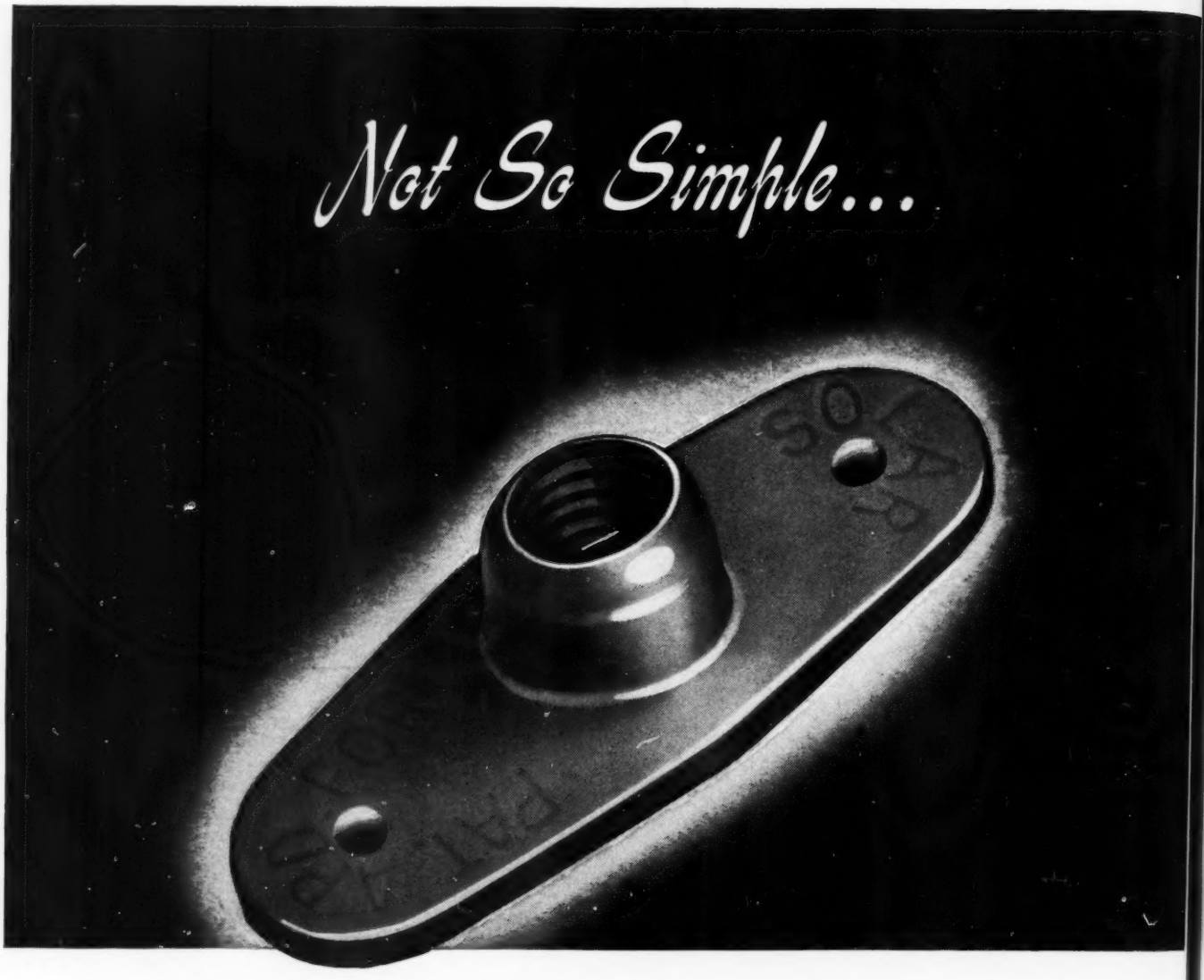
Cooperative Engineering Available–AIR-COM engineers have the "know-how" and experience. Let us help you solve your engineering problems of the future.

AIR-COM PRODUCTS

AIR COMMUNICATIONS, INC.

KANSAS CITY 8, MISSOURI

Designing, Engineering and Building for Victory... and the Future



...To Engineer A New Product!

This little self-locking nut plate is typical of Solar's challenging spirit which, fifteen years ago, brushed aside tradition to give the world the first really safe method of venting dangerous airplane gases—the Solar stainless steel exhaust manifold.

Two years ago there was a desperate need for self-locking nut plates for military plane production which would sustain high temperatures. Solar met the emergency with SOL-A-NUT... a stainless steel nut plate developed with Solar initiative on different principles of design and construction

SOL-A-NUT is simplicity itself—*now that it is finished.* But back of it are months of hard work and original thinking—of research and design—of material tests—trials in use—re-design and further tests.

It is not a simple matter to engineer new products, particularly those made of stainless steel and used where high temperatures prevail, or hot gases, acids and corrosion are encountered. This is the field in which Solar's experience and knowledge are at their best. Consult Solar on your problems. Address "Management".

ARMY E NAVY ARMY E NAVY

SOLAR

STAINLESS STEEL PRODUCTS

SOLAR

SOLAR AIRCRAFT COMPANY SAN DIEGO 12, CALIF. DES MOINES 5, I

Martin JRM-1 gets NEW FIRE EXTINGUISHING SYSTEM

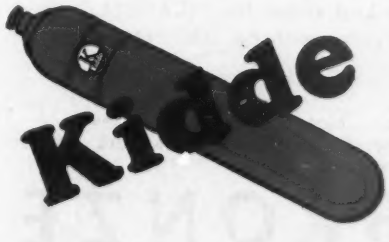
1st production installation in U. S. of methyl bromide extinguishing system

There's a new way to kill fire on the Glenn L. Martin JRM-1. For the first time production models are being equipped with built-in *methyl bromide* extinguishing systems. Walter Kidde & Company is proud to have scored this important *first* on the new production model of the great Martin *Mars.*

Methyl bromide, the new Kidde fire-killer, is a vaporizing liquid type of extinguishing agent which is extremely fast and effective against engine fires. Another important feature is the system's *extreme lightness in weight* . . . considerably less than other types of built-in systems. The new Kidde system is simple in design and operation.

For many months Kidde engineers have been busy in the development of a methyl bromide method, now perfected. This is not just an extinguishing system for the world's biggest seaplane. This new Kidde equipment means *a new step forward in air safety!*

Methyl bromide fire extinguishing gives great promise for today's military planes and commercial air transports. Walter Kidde & Company is prepared to discuss installation and performance data with interested manufacturers. Write us, on company letterhead, for full details on this new extinguishing method.

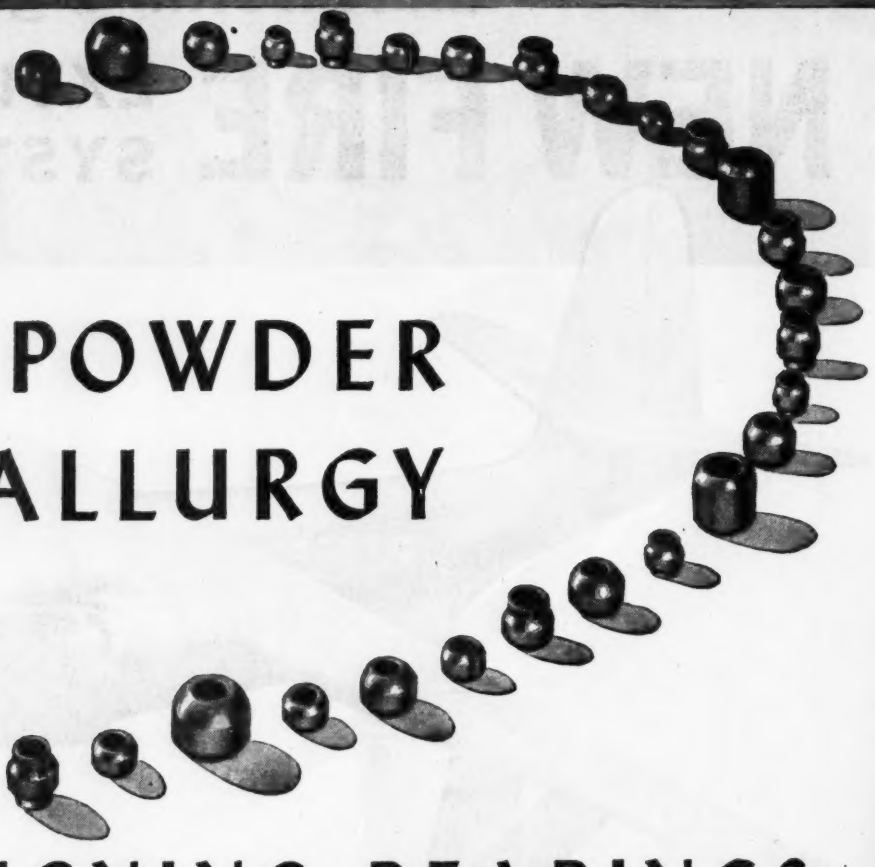


WALTER KIDDE & COMPANY, INC., 140 CEDAR STREET, NEW YORK 6, N. Y.

JOHNSON BRONZE

SLEEVE TYPE BEARINGS

Ledaloyl
SELF LUBRICATING
BRONZE



POWDER METALLURGY

for

SELF-ALIGNING BEARINGS

SLEEVE TYPE BEARINGS

Cast Bronze Bearings
Cast Bronze Graphited
Sheet Bronze Bearings
Sheet Bronze Graphited
Bronze and Babbitt Bearings
Steel and Babbitt Bearings
Steel and Bronze Bearings
Ledaloyl
Self-Lubricating Bearings
Electric Motor Bearings
Automotive Bearings
Bronze Bars
Bronze Castings

Any Type
Any Size
Any Quantity

● Before the development of the science of powder metallurgy, the many advantages of self-aligning bearings were often outweighed by the extra cost involved in producing them. This was due in great part by the intricate machining operations necessary. Now you can secure self-aligning bearings made from Johnson LEDALOYL Bronze . . . the newest development in powder metallurgy. This method of making bearings eliminates all machining, provides accuracy, and adds the extra advantage of self lubrication.

Designers of products for the future will do well to consider the use of Johnson LEDALOYL Bronze. This is true not only for bearings but for other small, intricate parts. Johnson LEDALOYL is made from pre-alloyed bearing bronze, and parts properly designed and installed will usually outlast the motive unit. In some cases, the self lubricating quality enables manufacturers to seal the bearing in place, thus eliminating the necessity of further lubrication and lubrication fixtures.

A Johnson Sales Engineer will gladly help you decide which applications you have that are best suited for LEDALOYL. There is one located as near as your telephone. Why not call him in—TODAY?

DISTRICT SALES OFFICES: Atlanta · Boston · Buffalo · Chicago · Cincinnati · Cleveland · Dallas
Detroit · Kansas City · Los Angeles · Minneapolis · Newark · New Castle · New York · Philadelphia
Pittsburgh · St. Louis · San Francisco · Seattle

JOHNSON BRONZE

SLEEVE BEARING HEADQUARTERS

The MOST COMPLETE SLEEVE BEARING SERVICE in the WORLD

620 S. MILL STREET NEW CASTLE, PA.

CARRIER PROTECTION
Our Air Forces are doing a grand job . . . made possible with good men and good equipment. Bush Intercoolers are playing an important part in helping our pilots get the jump on the enemy . . . and Bush experience in heat transfer, with its hundreds of commercial and industrial applications, may well enable you to get the jump on post-war competition. Our engineering staff will be glad to cooperate in your planning.
BUY WAR BONDS.
Bush Intercooler

meet the stars of the K

FLYING FORTRESS—B-17G

FAIRCHILD—C82

HELLCAT—F6F

Early in the war, Kenyon pledged ince—
America's plane builders "to deliver needed ven
precision parts, in quantity, on time— heir f
even if they have never been made be- WH
fore". The makers of many victory-win- nplic
ning airplanes have called on Kenyon ver in

HELL DIVER—SB2C

DAUNTLESS—SBD-1

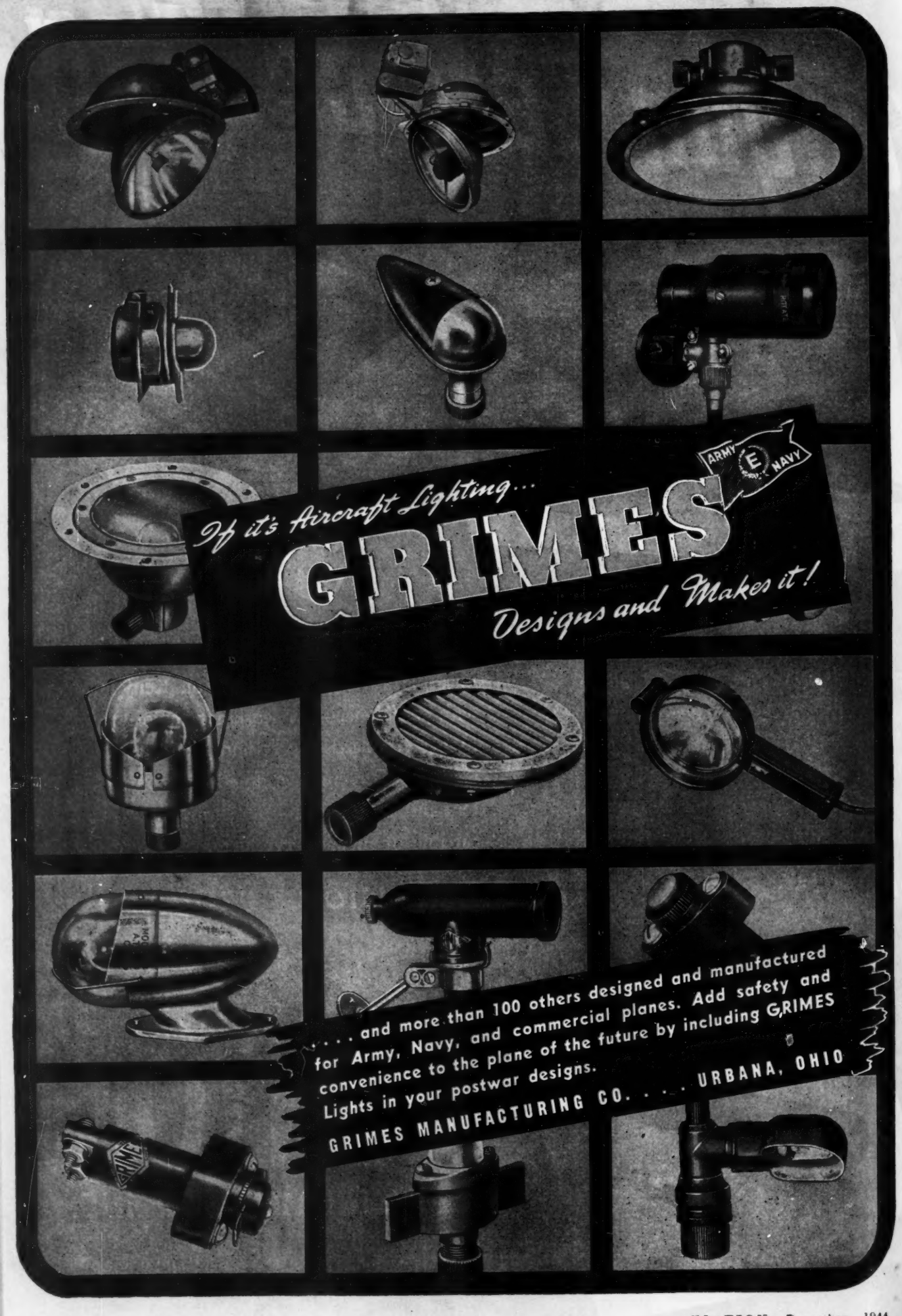
Kenyon Service Flag

ged nce—and we are proud to have played
ded en a small part in the production of
e— heir flying, fighting brood.
be- When the war job is done, the policy
win- nplicit in that promise will be carried
yon, ver into peacetime production. Now, and in the future, you can call on Kenyon with confidence—for workmanship of the highest standards of precision is the norm at Kenyon. Our engineering staff is competent and experienced—our shops and men capable of meeting production promises.

IONEERING • PRODUCTION • PRECISION • PROGRESS

KENYON
INSTRUMENT CO. INC.

HUNTINGTON, L. I. NEW YORK


If it's Aircraft Lighting...
GRIMES
Designs and Makes it!
ARMY E NAVY
. . . . and more than 100 others designed and manufactured for Army, Navy, and commercial planes. Add safety and convenience to the plane of the future by including GRIMES Lights in your postwar designs.
GRIMES MANUFACTURING CO. . . . . URBANA, OHIO

Now's the Time To Learn

ABOUT SOURCES OF SUPPLY FOR AIRCRAFT TUBING

ELECTRUNITE
Electric Resistance Welded Steel
AIRCRAFT TUBING
SIZE RANGES

O. D. OF TUBE	WALL THICKNESS (B. W. GAUGE)		
	STAINLESS*	SAE 1025	SAE X-4130 NE-8630
3/8"	16 to 22	16 to 22	18 to 20
7/16"	16 to 22		18 to 22
1/2"	16 to 22	16 to 22	16 to 22
9/16"			16 to 22
5/8"	18 to 21	16 to 22	16 to 22
11/16"	16 to 21		
3/4"	14 to 20	16 to 22	16 to 22
7/8"	14 to 20	14 to 20	16 to 20
1"	14 to 20	14 to 20	16 to 20
1 1/8"	14 to 20	13 to 20	16 to 20
1 1/4"	14 to 20	13 to 20	16 to 20
1 3/8"	14 to 20	13 to 20	16 to 20
1 1/2"	14 to 20	11 to 20	14 to 18
1 5/8"	14 to 20	11 to 20	16 to 18
1 3/4"	14 to 20	11 to 18	13 to 18
1 7/8"	13 to 20	10 to 18	
2"	13 to 20	13 to 18	13 to 16
2 1/8"	13 to 20	9 to 18	
2 1/4"	13 to 20	9 to 16	13 to 16
2 3/8"	13 to 20	9 to 16	12 to 16
2 1/2"	13 to 18	9 to 16	12 to 14
2 3/4"	13 to 18	9 to 16	
3"		9 to 16	
3 1/4"		9 to 16	
3 1/2"		9 to 16	
4"		9 to 16	
4 1/2"		9 to 16	
5"			

*These sizes can be made by welding direct to size (i. e. without cold drawing). Intermediate sizes, smaller diameters and wall thicknesses heavier than those shown above may be obtained if required. Square, rectangular, and special shapes available in limited range.

—and right now is the time to learn all about Republic ELECTRUNITE Aircraft Tubing and what it can do for you.

The table above, giving ELECTRUNITE analyses, sizes, and gauges—demonstrates the wide line of top-quality tubing available from a single source of supply—Republic Steel and Tubes Division. (Handy pocket-size cards bearing this table are yours for the asking.)

The use of countless thousands of feet of this tubing for wartime aircraft construction has demonstrated its consistent uniformity in wall thickness, diameter, concentricity, ductility, strength, weight and smooth surface—and its easy workability and weldability. It has been proved sound in every respect both by performance in service and by FARROWTEST — the most accurate commercial method for testing tubing.

ELECTRUNITE Tubing meets standards of the U. S. Army Air Forces; The Bureau of Aeronautics, U. S. Navy; The Civil Aeronautics Administration; and the Aeronautical Material Specifications (AMS) of the Society of Automotive Engineers. Write us for further information and as many size range cards as you need.

REPUBLIC STEEL CORPORATION
STEEL AND TUBES DIVISION • CLEVELAND 8, OHIO
Berger Manufacturing Division
Culvert Division • Niles Steel Products Division
Union Drawn Steel Division • Truscon Steel Company
Export Department: Chrysler Bldg., New York 17, N. Y.

BUY WAR BONDS AND STAMPS
—THEN KEEP THEM

Republic
ELECTRUNITE*
*Reg. U. S. Pat. Off.
AIRCRAFT TUBING

METAL STAMPINGS OF QUALITY

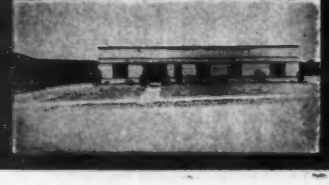
The Metal Specialty Co. is completely equipped to give you efficient service in Stamping, Rolling, Coining, Forming, Drawing and Annealing in all Metals. Specialists in Hydraulic cold drawing and embossing in all metals including stainless steel. Deep drawing and embossing up to 850 tons capacity. Shells drawn up to 20" in depth. Assembling including Spot Welding and Hydrogen Brazing. Pressed Metal products to order.

A complete Plastic Injection Molding Division to fulfill your exacting requirements. Up through 18-oz. moldings.

MAIN OFFICE — PLANT
Este Ave. & Orient Streets
Cincinnati 32, Ohio

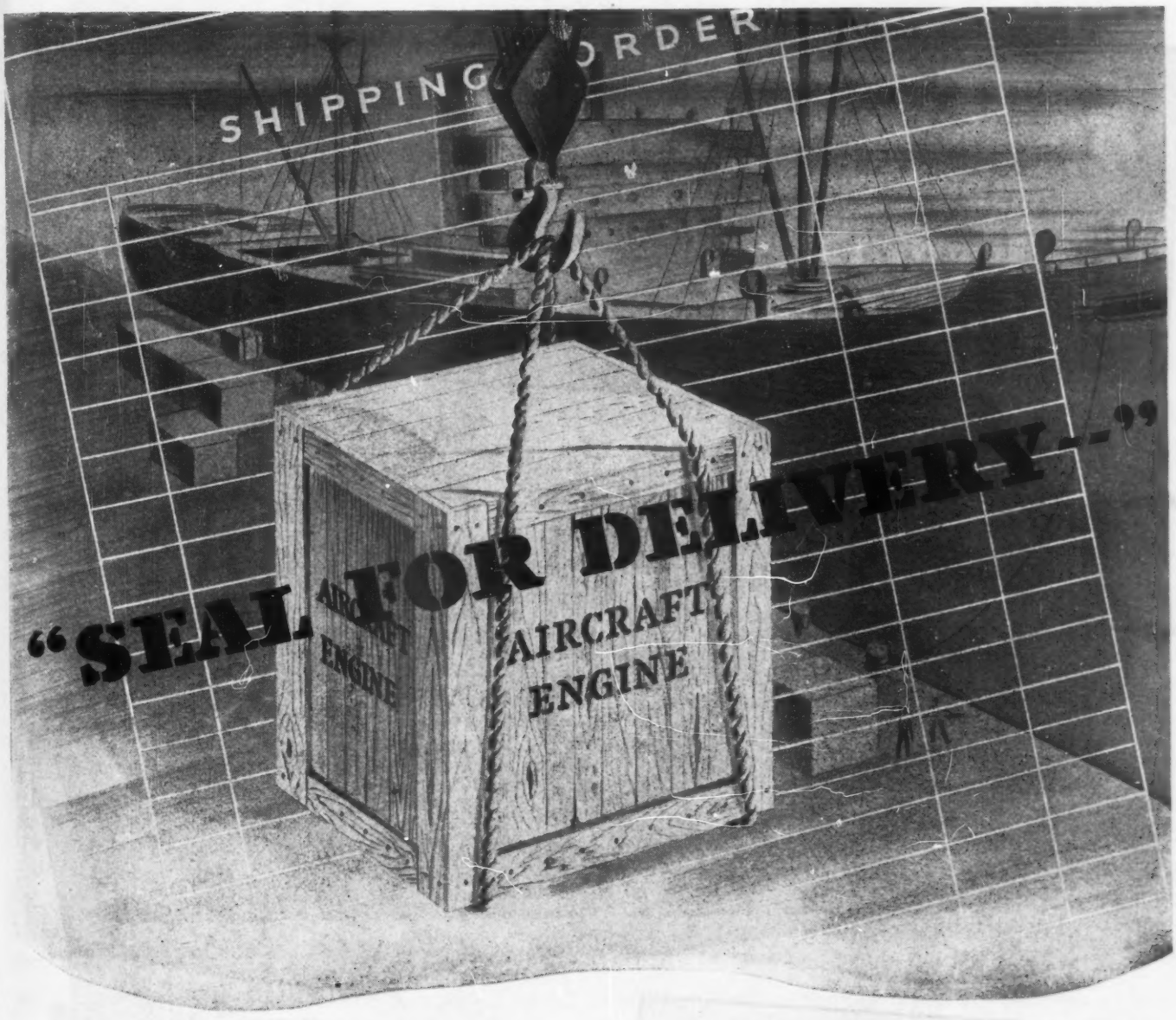
BRANCH OFFICE — SALES OFFICE
South L Street
Richmond, Ind.

SALES OFFICE
West Grand Blvd.
Detroit, Mich.



The
METAL SPECIALTY *Co.*

MAIN OFFICE AND PLANT • ESTE AVENUE • CINCINNATI, OHIO



Casual words those, stamped on a shipping order. But it took Union Oil research chemists many months to make them possible.

For it is one thing to protect an engine against outside conditions but it is quite another to seal *internal* surfaces against corrosion.

The fact that Union Oil Company's Stop Rust B is used by leading Pacific Coast aircraft companies for processing engines for storage and shipment is definite proof that this compound successfully meets all requirements for internal rust prevention.

Stop Rust B forms a non-drying, non-hardening film which adheres to metal for indefinite periods – completely sealing every surface against rust. Engines protected with Stop Rust B may be placed in service immediately without special cleaning or servicing, as it mixes readily with all commercial fuels and lubricants.

In addition, Stop Rust B is a detergent as well as a rust preventive, and engines operated on the proper mixture of lubricating oil and Stop Rust B remain clean and free from sludge. Stop Rust B contains an active ingredient to neutralize any acid residues which may be left in the engine from fuel combustion. Stop Rust B meets specifications AN-VV-C-576a and is used in accordance with instructions governing processing of aircraft engines.

For a supply of this revolutionary rust preventive – or any other of Union Oil's quality aviation products – phone your local Union Oil Company representative, or write Union Oil Company, 617 West Seventh St., Los Angeles 14, Calif.

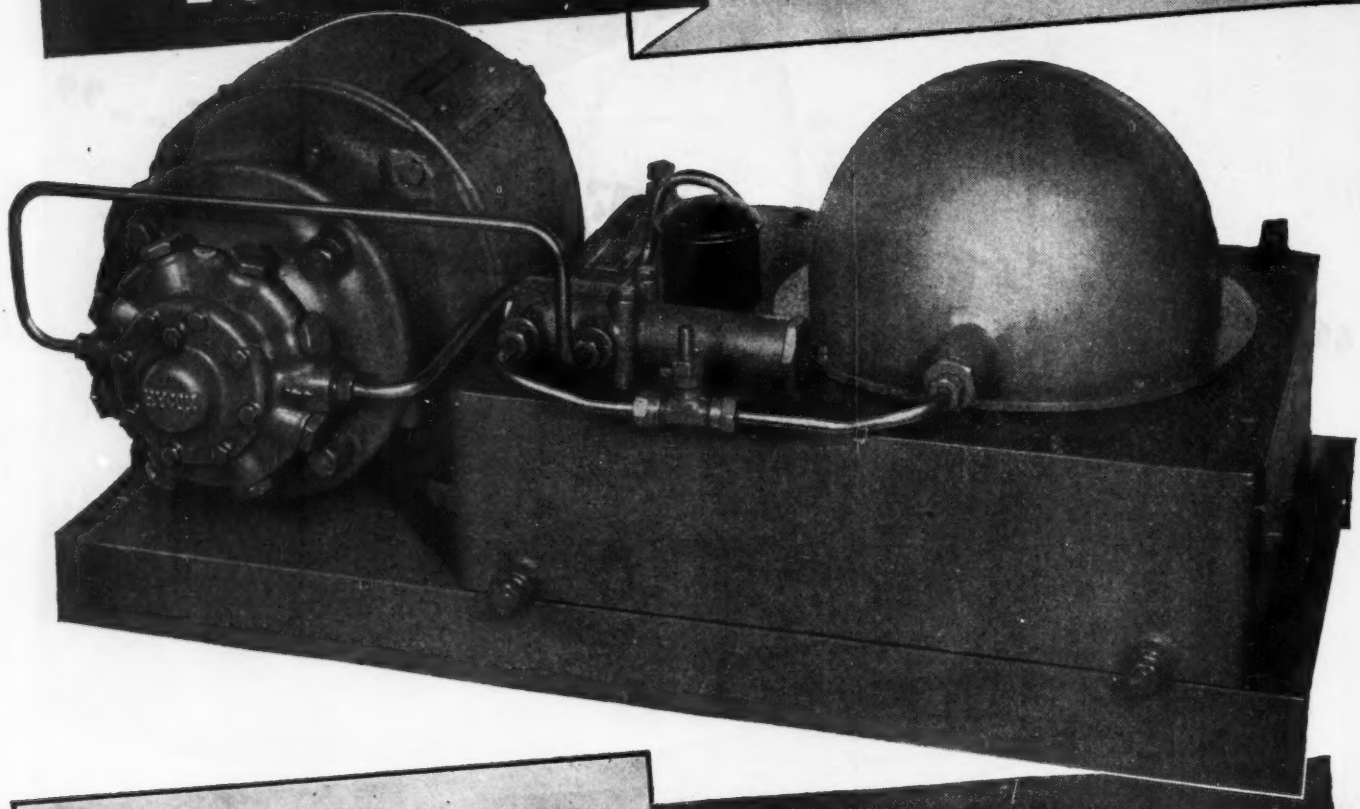
STOP RUST B

Another
UNION OIL
Success-Tested Product

HYCON

3000 p.s.i. Hydraulic Power Unit

3 HP Motor
8 cylinder Pump
Unloading Valve
Accumulator and Reservoir



A small compact unit for machine tools, hydraulic presses and test equipment

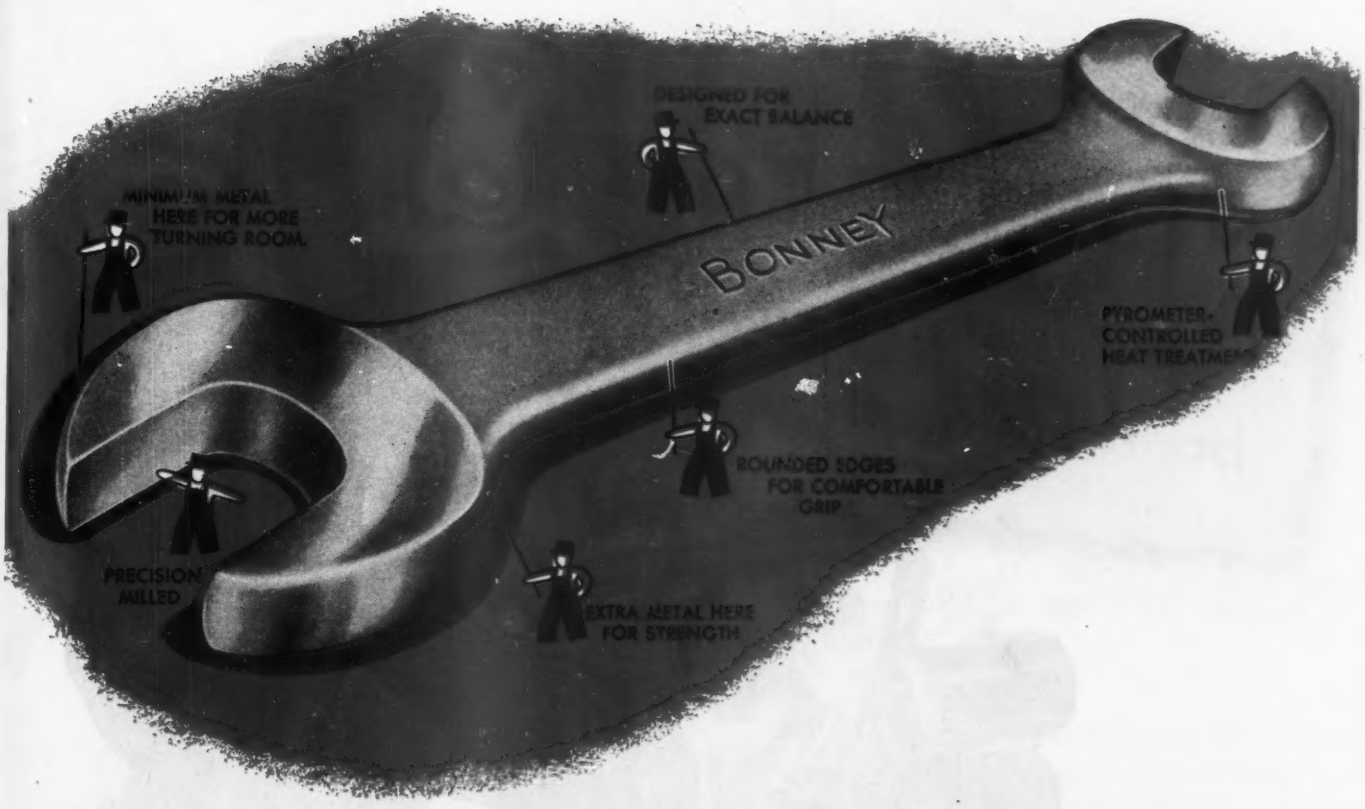
Quickly and easily installed for smooth reliable hydraulic operations up to 3000 p.s.i.

Specifications and Engineering Data on Request

THE NEW YORK AIR BRAKE COMPANY

Hydraulic Division

420 Lexington Avenue, New York 17, N. Y. Factories: Watertown, N. Y.



It's Easy to See Why They're Better...

It's a funny thing about wrenches. You use them all day long. They're the most important tools in your kit. You know which ones do the job best—which ones last the longest. But chances are you never stop to think why.

When you take a good look at a Bonney Wrench, it's so easy to see why it's better.

The openings in a Bonney Engineers' Wrench, for instance, aren't just milled—they're *precision-milled*. They fit the nut exactly—no slipping, no forcing. The jaws are tapered to give you more turning room. They're reinforced with extra metal at the points of strain. The handles are rounded for an easy, comfortable grip. And something you can't see—to make Bonney Wrenches the strongest and toughest on the market, each one is given our special pyrometer-controlled heat treatment.

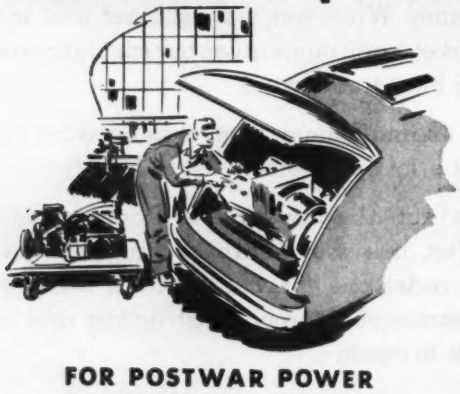
We put a lot into Bonney Wrenches because we want you to get a lot out of them.

If you do not already have a Bonney Engineers' Wrench Set, ask your nearby Bonney distributor or jobber to order one for you now. All Bonney Tools are sold exclusively through distributors and jobbers from coast to coast.

BONNEY FORGE & TOOL WORKS · 711 N. MEADOW ST. · ALLENTOWN, PA.

In Canada: Gray-Bonney Tool Company, Ltd., St. Clarens & Royce Aves., Toronto

will deliver peacetime power for YOU tomorrow



FOR POSTWAR POWER

Andover Engine alone weighs just under 82 pounds.

With generator and adapter only 116 pounds.

THIS auxiliary power unit, developed originally by Andover for use in military aircraft, has made a consistent record of dependable service not only on Uncle Sam's B-29 bombers but also on many other types of multi-motored airplanes.

Now Andover has ready for peacetime American industry a compact power unit which offers unlimited possibilities in every application for a portable source of power.

It can be used with generators to supply electric power on demand; it can readily be adapted to operate any mechanical apparatus where compactness and portability are desired and . . . of course . . . economy.

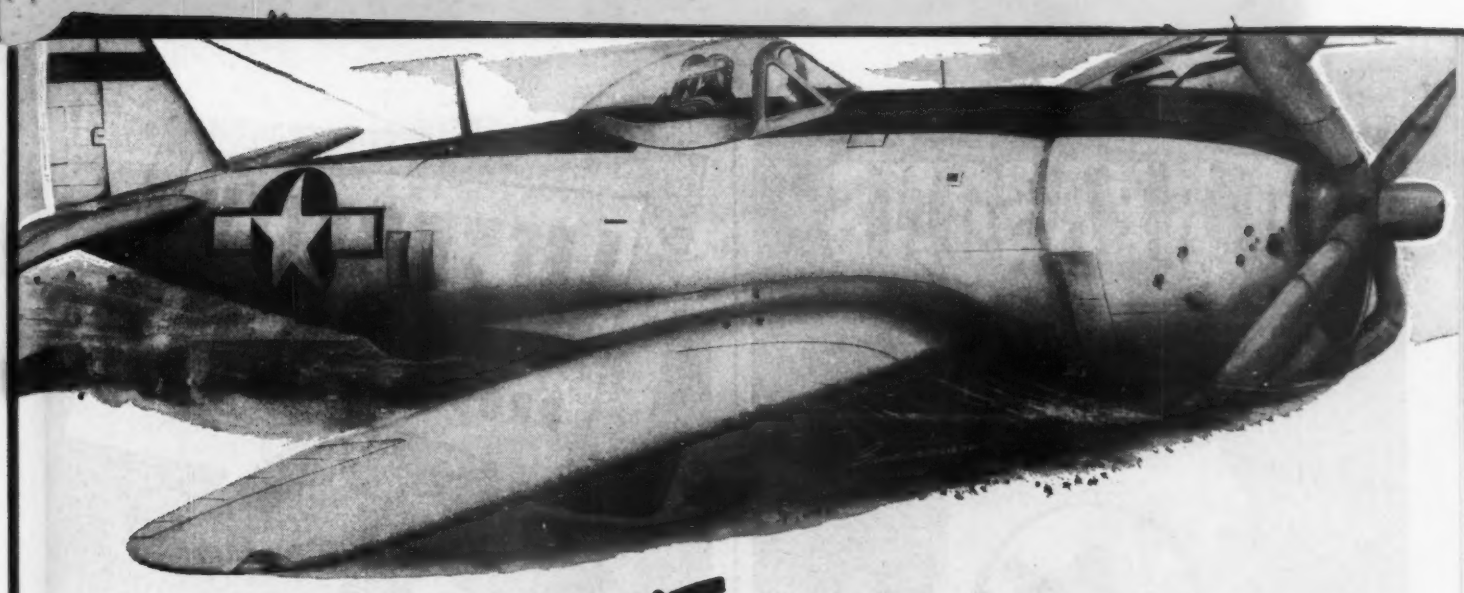
It can be easily mounted and transported. Indeed, its versatility will simplify operations in many peacetime industries.

Our informative booklet "Andover Auxiliary Power" may suggest how this motor can help you in the coming era of peace and expansion . . . yours for the asking.

Andover
AUXILIARY
POWER

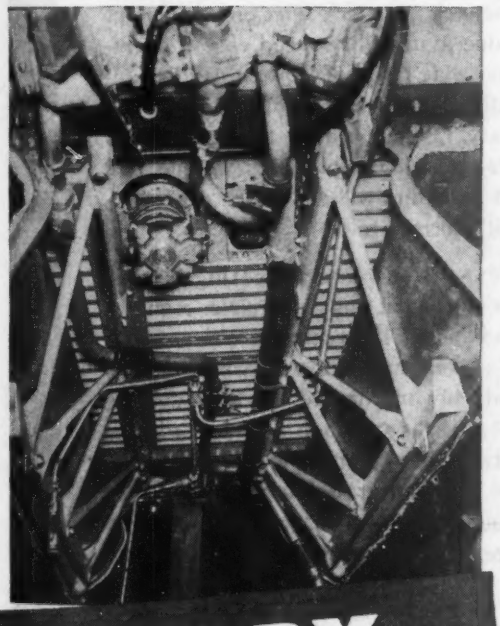
ANDOVER MOTORS CORPORATION • ELMIRA, N. Y.

WHOLLY-OWNED SUBSIDIARY OF ANDOVER KENT AVIATION CORPORATION



A THUNDERBOLT Takes a "belly-whopper" SAFELY!

Shelby Seamless Steel Tubes are used to brace the crash skids of the P-47 Thunderbolt. On the strength of these braces largely depends the safety of both pilot and plane when a forced landing without landing gear must be made.



FOR paralyzing attacks at tree top level or for police duty in the stratosphere, the Thunderbolt serves equally well. Pilots love it because it packs a powerful punch. It flies high, fast, and far and is more heavily armed and armored than any other single-engined fighter.

In fighter-bombers, trainers and scout planes, SHELBY Steel Tubing provides maximum strength in vital parts with minimum weight. Engine mounts and landing gear successfully absorb tremendous vibrations from powerful motors and rough landing fields. Spar chords, wing struts and braces resist the strain of sudden maneuvering and dives—faster than 700 miles per hour.

In countless applications SHELBY Seamless Steel Tubes have proved they can do the tough jobs which aviation expects. In Thunderbolts, Commandos, Flying Fortresses, Liberators and dozens of other planes where the elimination of dead weight is an important consideration, seamless steel tubes have been chosen because they have a higher strength-weight ratio than any other type of construction. No matter what type of aircraft tubing you need, NATIONAL's Complete Aircraft Tube Service can furnish it.

SHELBY SEAMLESS *Aircraft Tubing*

WALLS WITHOUT WELDS

NATIONAL TUBE COMPANY

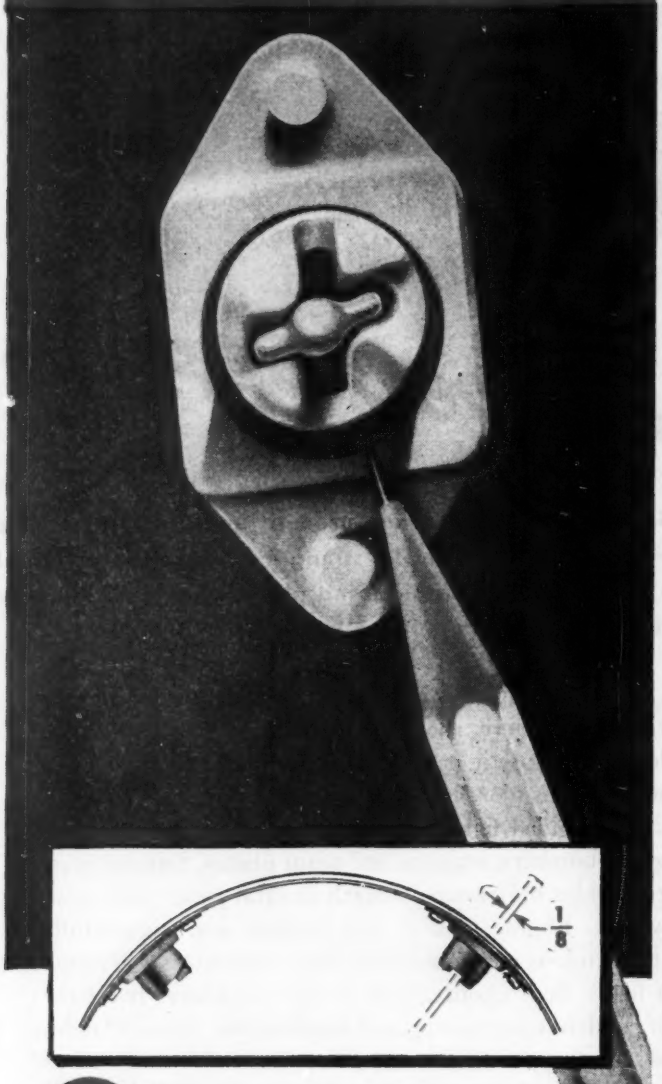
PITTSBURGH, PA.

Columbia Steel Company, San Francisco, *Pacific Coast Distributors*
United States Steel Export Company, New York

USS

UNITED STATES STEEL

10 REASONS



No. 2 FREE FLOATING RECEPTACLE

Camloc's unique spring-in-stud design permits wide choice of receptacles resulting in extreme flexibility of application. Camloc's free floating receptacle is one of the most popular, since it allows up to 1/8" misalignment in any direction. Stud always enters receptacle at correct angle even on sharply curved installations. Jamming due to reverse thrust is impossible. Watch for reason No. 3 in our next advertisement and write for complete information.

CAMLOC

CAMLOC FASTENER CORP.
420 Lexington Avenue, New York 17
5410 Wilshire Boulevard, Los Angeles 36

QUICK-ACTING FASTENERS

© Camloc Fastener Corp.

LECTROETCH BENCH PRODUCTION UNIT

THE Lectroetch bench production unit is probably the most popular etcher on the market today due to its utility, speed, ease of operation and wide range of work. It can be conveniently placed on operator's bench where it is easy, fast and simple to operate. It is ideal for marking flat, cylindrical and odd shaped parts and will not in any way interfere with surface tolerances.

An inexpensive plastic locating fixture assures consistent uniform register of markings on all parts. This remarkable electrolytic stencil etcher can be operated manually or automatically and handles intricate designs or trademarks as easily and legibly as ordinary characters. They can be operated by anyone without any danger because there are no acids used, no fumes, heat or shock, no stress, strain or deformation on the parts marked.

Send in for free literature; chances are we have the answer to your parts marking problem in one of our standard etching units as shown below.

THE LECTROETCH CO.
1727 DOAN CLEVELAND 12, OHIO

. . . With His Aeronca Program For A Small Airport!

"Anyone can *build* an airport", Joe told the City Fathers, "but here in Centerville we want our airport to be a *paying proposition!* I've given a lot of thought and study to this problem, and I'm convinced that *Aeronca* has the answers. The Aeronca program is based on 16 years of leadership in the personal plane business, and includes lessons learned by scores of successful Aeronca airplane dealers operating from small airports."

No wonder the Council unanimously agreed when Joe concluded, "I think we ought to get *all the facts* from Aeronca right now!"

Plan—today—to make the small airport in *your* community a profit-maker. Find out about Aeronca's *complete program.* Fill out and mail the coupon without delay, and lay the foundation for *your* success in post-war aviation!

Small Airports Can Pay! Get These Important Books Now!

AMERICA'S PERSONAL PLANE

AERONCA

AIRCRAFT CORPORATION

MIDDLETOWN, OHIO

Al Bennett, Director of Sales,
Aeronca Aircraft Corporation, Middletown, O.

Please send me the illustrated booklets checked below. I enclose 10c for each booklet.

☐ "HOW TO MAKE SMALL AIRPORTS PAY WITH AERONCA"
☐ "WHY YOU SHOULD BE AN AERONCA DEALER"

Name.....

Address.....

City and State..... H-12

ANSWERING SOME HELICOPTER QUESTIONS

The past century has witnessed the development of the telegraph, electric light, telephone, automobile, airplane, radio and many other industrial marvels, which are still in the process of transforming living conditions throughout the world. And today there is wide enthusiasm over *another* revolutionary development—the helicopter . . . and wide curiosity concerning *its* future possibilities.

Therefore it is timely to publish a sincere and factual appraisal of the helicopter and an informed statement of the part it may play in future progress. As one of a dozen or more substantial and conservative industrial organizations engaged in helicopter development—the oldest in the rotary wing field—Kellett Aircraft Corporation accepts this opportunity to present some helicopter facts and to state the opinions of its management and engineering staff on the future of the helicopter.

DEVELOPMENT HAS BEEN RAPID

Today, in the United States, a half dozen or more different helicopter types are flying. To the best of our knowledge, helicopters are flying in no other country, and only in the United States is effective research and production being carried on. This is largely due to the sponsorship received from our military services during the war period.

WHAT CAN HELICOPTERS DO?

The helicopter, as a matter of normal flying operation, can rise straight into the air from a standing start; land in the same way; hang motionless in the air at low altitude over a given point for as long as the pilot wishes; fly backwards as easily as your automobile reverses; move directly sideways; fly safely inside a large auditorium.

ARE HELICOPTERS EASY TO FLY?

The men who pilot helicopters today are carefully trained, experienced men. Flying a helicopter is not a job for a novice. Many controls must be coordinated and the pilot must possess excellent skill and judgment. However, these "experts" are otherwise average individuals and one or two of them had never had experience in flying before they stepped into helicopters. It is reasonable to expect that "ease of flying" will be improved with further engineering developments.

WHAT WILL HELICOPTERS COST?

Helicopters, if they could be purchased on the market today (which military requirements will not permit), would be more expensive than the most costly automobile. Engines, intricate transmissions, control mechanisms and rotor blades require special design and construction methods. Helicopters are likely to be costly for some time to come. Of course, if the efficiency of mass production and the competitive enterprise system are permitted to have their effect, the cost is certain to come down.

ARE HELICOPTERS SAFER?

It has not yet been demonstrated that a helicopter is any more safe or less safe than other aircraft. Conventional airplanes have established impressive records for safety.

WHO WILL USE HELICOPTERS?

It is our belief that helicopters will have their first important usefulness in fields where other forms of transportation cannot serve. In many situations the helicopter will introduce important savings of time, manpower and money. For instance, in the spraying of agricultural crops, inspecting and servicing of cross country oil pipe lines and electric transmission lines; forest and shore patrol; prospecting; in mail and passenger service to areas otherwise inaccessible by air.

WILL HELICOPTERS BE FAST?

As aircraft, helicopters today are not very fast. To a world which accepts 400 m. p. h. flight as commonplace, they may never become "fast" aircraft. BUT the helicopter's as-a-crow-flies travel is much faster than automobile or train transportation, and even faster in some cases than the combination of land and plane travel which present-day air transport entails. The practical helicopter will not require a trip to an airport as a necessary preliminary to a flight.

WHAT ABOUT HELICOPTER CAPACITY?

Helicopters are still in the medium-power, cabin class. It may be some time before a type will develop which will cruise more than a few hundred miles without refueling or which will carry more of a load than a sedan.

HOW RAPIDLY WILL HELICOPTERS BE PERFECTED?

As in the case of the airplane, development of the helicopter is a matter of engineering. The present-day airplane is the result of many millions of engineering-man-hours over a period of years. The present-day helicopter is the result of several hundred thousand engineering-man-hours over a period of years—inconsequential as yet, compared with the engineering applied to the airplane of today. Over the years to come, additional millions of engineering-man-hours must be expended in order that the helicopter shall make its maximum contribution to progress. How soon that goal is reached depends on the rapidity with which the engineering investment can be made.

KELLETT HELICOPTERS

Kellett Aircraft Corporation has been a designer and builder of rotary wing aircraft for fifteen years. We have confidence in our ability to provide after-the-war helicopters which will be practical for many commercial uses. We look forward to widening fields of service—along with other aircraft manufacturers—in a better, happier, more air-minded future. Kellett Aircraft Corporation, Upper Darby (Philadelphia), Pa.

KELLETT

OLDEST ROTARY WING AIRCRAFT MANUFACTURING COMPANY

ELECTRICALLY OPERATED *ACTUATORS*

Air Associates Electric Actuators, available in all sizes, are designed and engineered for maximum service.

Each has a lightweight motor with built-in clutch and brake—and a torque limiting clutch where required . . . spur gear reduction to high efficiency screw jack . . . hardened steel screw with special thread form and high strength nut of bronze alloy . . . positive stops at each end of screw to control travel . . . built-in limit switches, easily adjustable from outside. Actuator shown weighs under 5 lbs., is suitable for working loads of 1,500 lbs. and static loads of 2,000 lbs. . . . *Your requirements promptly filled through any Air Associates office.*

AIR ASSOCIATES, INC.

TETERBORO, N. J. . . . *BRANCHES:* CHICAGO, DALLAS, LOS ANGELES . . . ENGINEERS & MANUFACTURERS OF AIRCRAFT SPECIALTIES . . . SUPPLIERS OF ALL TYPES OF MATERIALS TO THE INDUSTRY SINCE 1927

Typical Jobs

Drawing and Blanking Die "Saves time in producing smooth base metal finish."

Compressor Yoke. Alignment maintained and better finish produced.

Mild Steel Clevis. Honing corrected errors of previous operations and maintained true alignment of two holes.

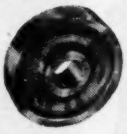
Automobile Distributor Shaft Gears. Taper removed at a rate of 80-90 per hour.

Aluminum Aircraft Link produces high finish without bell-mouthing.

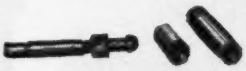
Bearing. A very small part. 2 micro-inch finish necessary.

Shell Loading Die.

Stainless Steel Load Compensator Valve Seat. Hole is honed to .0002" limit.



Aircraft Valve Tappet Roller. Honed after grinding to give 100% bearing surface.



Airplane Engine Parts accurately honed to a super-smooth finish.

Idle Valve Guide. Honing after grinding holds a .0002" limit necessary for accurate idling.

Roller Bearing Outer Race. Finish improved from 12 micro-inches to 2 micro-inches.

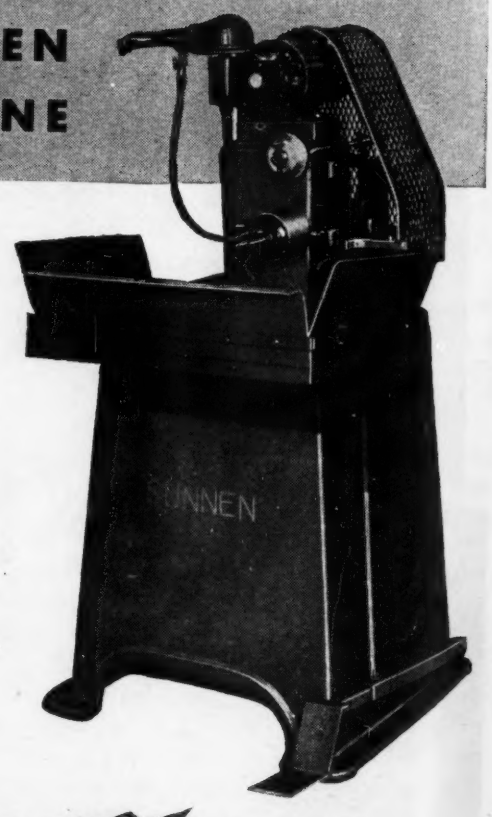
Cast Iron Valve Stem Guide. 1/2 to one thousandth removed—220 pieces per hour. Better finish and straighter hole.

Hydraulic Control Bushing. Honing gives straight round hole after rough reaming.

Aviation Hydraulic Cylinder made of Aluminum-Alloy. Improves the quality of the bearing surface. An extremely smooth surface-finish. is secured.

PARTS LAST LONGER

When Honed on the SUNNEN PRECISION HONING MACHINE

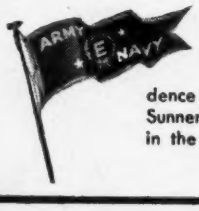


Time after time, users of the Sunnen Precision Honing Machine have shown that they get longer service and have fewer repairs than by any previous method of internal finishing.

There's a good reason for these results, too. This machine has an amazing record for accuracy. Straight, round holes are produced with a guaranteed accuracy of .0001". Accuracy has been held to .000025" on hardened steel jobs. A super-smooth finish of from 2 to 3 micro-inches provides a better working surface.

A new base and pump assembly, recently introduced, has improved results still further. The pumping unit provides a constant flow of honing fluid that acts as a coolant, carries away cuttings, and keeps the abrasive stone in sharp cutting condition.

There are many other reasons why the low-cost Sunnen Precision Honing Machine will give you a finish that makes parts last longer. Get complete information by calling a Sunnen engineer to your plant—or write for free bulletin.



The coveted Army-Navy "E" waves over the Sunnen plant, evidence of the important part Sunnen equipment is playing in the war effort.

SUNNEN

SUNNEN PRODUCTS COMPANY • 7942 Manchester Avenue • St. Louis 17, Missouri

Canadian Factory: Chatham, Ontario

FOR AIRCRAFT ENGINES...AN AIRCRAFT SPARK PLUG

First... *Reliability*

Above all else, BG Spark Plugs are built to be *reliable.* Their advantages include economy of flight operation and more flying hours per plug—but *reliability of performance* is the big consideration. For this they were designed by aircraft spark plug specialists, and so that you can be sure yours are reliable, each BG plug is inspected and tested many times during its manufacture.

This inbuilt reliability is one of the reasons why BG Spark Plugs have been standard airline equipment for many years.

BG

ARMY (E) NAVY

THE BG CORPORATION

136 WEST 52ND STREET, NEW YORK 19, N. Y.

Manufacturers of both mica-insulated and ceramic-insulated aviation spark plugs

Contractors to the United States Army, Navy and Coast Guard and Aircraft Engine Builders

REVOLUTIONARY

when first introduced by Plomb

MADE FOR SPEED
. . . use it this way

Loosen nut with box end—it's strong and safe.

Turn wrench end for end.

Use open end to run nut off quickly.

Plomb makes the most complete assortment of this type of wrench — 18 opening sizes from 5/16" to 1-7/16"; lengths from 3-1/2" to 19".

STILL THE *Leader* IN PERFORMANCE

PLOMB combination box and open end wrench

Often imitated but never equalled, only the Plomb Combination Box and Open End Wrench gives you all the features shown. Originally the one and only of its kind, continuous improvements keep it the one and only for maximum speed and efficiency.

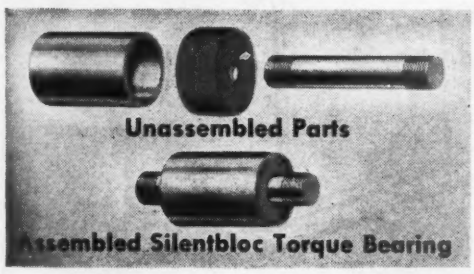
All other tools in the Plomb line are equally outstanding. Expert mechanics know this—choose them for better, safer, longer-lasting service. Buy them today from your Plomb Distributor or write for name and address of the one nearest you. Free catalog on request. —Plomb Tool Company, 2221 Santa Fe Ave., Los Angeles 54, Calif.

PLOMB

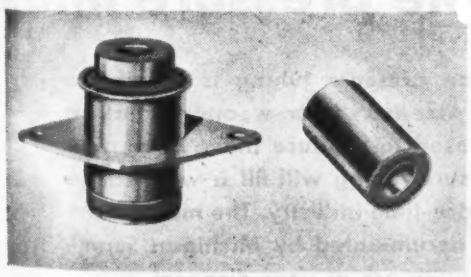
FINE HAND TOOLS

Silentbloc in Your New Blueprints Means a Better Product...Lower Costs

Silentbloc Rubber Mounting above is used to damp or isolate vibration and cushion shock loads in motors and other moving equipment.



PATENTED CONSTRUCTION gives engineered performance. Silentbloc consists of outer metal sleeve into which rubber ring is forced under high pressure and inner shaft, "shot" through rubber. Radial compressive force of elongated rubber forms indestructible rubber-to-metal union.



SILENTBLOC Mounting gives engineered control of vibration in motors and moving equipment, cushions shock loads, absorbs noise.

SILENTBLOC Bushing corrects for misalignment of hinges, shafts, bearings. Improves operation, cuts machining and fitting costs.

BEFORE you approve any blueprint, check the improvements you might make with General Silentbloc mountings, bearings and bushings.

If you have a problem of vibration, shock load or noise, a Silentbloc mounting can be engineered for your specific needs.

If your equipment has oscillating parts, a Silentbloc rubber torque bearing can simplify construction and give trouble-free operation without lubricants.

You can improve performance and cut production costs with Silentbloc rubber bushings that correct for misalignment of shaft supports or bearings.

General Silentbloc parts can be made any size, to carry loads of ounces to tons, using any kind of metal and rubber. Skilled General engineers can design a Silentbloc to give the exact performance you specify.

Silentbloc has been proved in use on automotive, industrial, marine and home machinery, electrical equipment, aircraft and other products. *Silentbloc belongs in your new-product blueprints.*

It Will Pay You to Know More About Silentbloc

For factual booklet, write The General Tire & Rubber Company, Dept. 85, Wabash, Ind.

The GENERAL SILENTBLOC
MOUNTINGS ... BEARINGS
COUPLINGS

THE GENERAL TIRE & RUBBER CO.

Mechanical Goods Division, Wabash, Indiana

Seamless Steel Tubing . . .

provides strength for dependable pressure lines

Seamless steel tubing is being given wider and wider acceptance in industry as pressure, fuel and fluid lines. Engineers recognize the added strength embodied in solid steel walls. Other obvious advantages include light weight due to thin walls, freer passage of fluids, easier shaping and resistance to fatigue.

Today Michigan pressure tubing is playing a major role in America's war weapons and on the machines used to produce them. Tomorrow Michigan pressure tubing will fill a wide range of needs in peace-time industry. The many years of experience accumulated by Michigan Seamless Tube company are at your disposal.

AIRCRAFT • MECHANICAL • PRESSURE • STRUCTURAL

MICHIGAN SEAMLESS TUBE COMPANY

SOUTH LYON • MICHIGAN

NOTICE

A DISTINGUISHED NEW NAME for A DISTINGUISHED OLD SCHOOL, A NAME THAT, IN THE SUPREME TEST OF WAR HAS COME TO SIGNIFY A NEW HIGH STANDARD IN AVIATION TRAINING . . . .

CAL-AERO TECHNICAL INSTITUTE

MAJOR C. C. MOSELEY — PRES. SINCE 1929

FORMERLY CURTISS-WRIGHT TECHNICAL INSTITUTE

When Major C. C. Moseley, president of Cal-Aero Technical Institute, was selected by the Army Air Forces as one of nine civilian school operators to conduct the radical experiment of training Army Air Force pilots in civil schools, the name "CAL-AERO" came into existence. So successful did the plan prove that the Army went entirely out of the business of giving primary training, and ultimately 64 such schools, the majority of them patterned after "CAL-AERO," sprang up throughout the nation. At the same time and under the same personal supervision of Major C. C. Moseley, the great school which had trained thousands of civilians as mechanics and engineers since 1929, and that hereafter will be known as CAL-AERO TECHNICAL INSTITUTE was training 7,500 Army Air Force ground crew members. It was the first school—and for a long time the only school—in the west, to be selected by the Army to do this training.

With an unmatched and unparalleled record of efficiency and safety in training more than 20,000 Army Air Force pilots; more than 1200 having been decorated for valor; together with this school's record of training Army Air Force technicians, all under the personal supervision of Major C. C. Moseley since 1929; it was but natural in planning for the post-war period that these schools come under the distinguished name of "CAL-AERO."

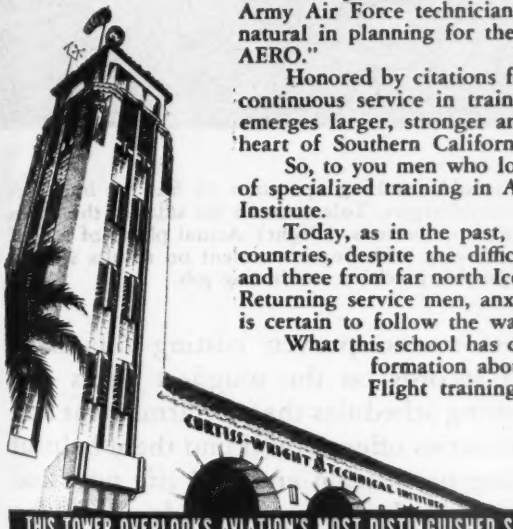
Honored by citations for distinguished service in training these men for the Army Air Forces, together with continuous service in training civilians for the production front, CAL-AERO TECHNICAL INSTITUTE emerges larger, stronger and finer than ever before, on its own airport, Grand Central Air Terminal, in the heart of Southern California's giant aircraft industry.

So, to you men who look forward to a career in AVIATION, you will find the best to be had in the way of specialized training in Aeronautical Engineering and Master Aviation Mechanics, at "CAL-AERO" Technical Institute.

Today, as in the past, civilian students continue to pour into this school from many states and foreign countries, despite the difficulties of war time travel. In one recent week, two students from far south India and three from far north Iceland arrived simultaneously. Latin America and China both are heavily represented. Returning service men, anxious to fit themselves for an outstanding place in the golden age of Aviation, which is certain to follow the war, likewise are enrolling upon discharge.

What this school has done for its graduates, it can do for you. Write or mail coupon today for full information about the possibilities of a post-war aviation career.

Flight training is restricted to Army Air Force Cadets for the duration.



THIS TOWER OVERLOOKS AVIATION'S MOST DISTINGUISHED SCHOOL OF AERONAUTICS

BE WISE—PROTECT YOUR FUTURE

MAIL TODAY • DON'T DELAY

WITHOUT COST OR OBLIGATION SEND ME FULL INFORMATION AND CATALOG ON THE COURSE CHECKED BELOW

- ☐ AERONAUTICAL ENGINEERING COURSE
- ☐ MASTER AVIATION MECHANIC COURSE
- ☐ SPECIALIZED ENGINE COURSE
- ☐ SPECIALIZED AIRPLANE COURSE
- ☐ POST GRADUATE AERONAUTICAL ENGINEERING COURSE
- ☐ SPECIALIZED AIRCRAFT SHEET METAL COURSE
- ☐ AERONAUTICAL DRAFTING COURSE. HOME STUDY
- ☐ AIRCRAFT BLUE PRINT READING COURSE. HOME STUDY

NAME _____

ADDRESS _____

CITY _____ STATE _____

AV-12

DATE OF BIRTH _____

CAL-AERO TECHNICAL INSTITUTE

FORMERLY CURTISS-WRIGHT TECHNICAL INSTITUTE

GRAND CENTRAL AIR TERMINAL
1226 AIRWAY, GLENDALE 1, CALIFORNIA
(LOS ANGELES COUNTY)

UNDER PERSONAL SUPERVISION OF MAJOR C. C. MOSELEY, PRESIDENT AND FOUNDER, SINCE 1929

ON OUR OWN AIRPORT - IN THE HEART OF THE AIRCRAFT INDUSTRY

"WITH **Gulf Cut-Aid**

WE INCREASED PRODUCTION ON THIS MILLER 10%

——TOOL LIFE 50%

—says this Superintendent

(Left) Close-up of straddle milling operation on fins for impellers of geared aircraft superchargers. Tolerance on the sides of the fins is critical as to finish and dimensions. (Right) Actual photo of a Gulf Service Engineer consulting with Superintendent on results secured with Gulf Cut-Aid on this precision machining job.

GULF CUT-AID PROVED SUPERIOR to 12 other brands of cutting oil we tested for straddle milling aluminum alloy supercharger impellers," says this Superintendent. "With this revolutionary new cutting oil, we get 10% greater production and 50% longer tool life than with the cutting fluid we used previously."

This is one of hundreds of war plants that have increased production and tool life on precision work by using the proper Gulf Cutting Oil for each particular job requirement.

Gulf performance-proven cutting oils have established records on the toughest steels and most punishing schedules that the armament and aircraft industries offer. You'll find them helpful in improving production and tool life now and in paring costs below competitive levels in the postwar period.

Let a Gulf Service Engineer show you why Gulf Cutting Oils are ideal for many of your machining jobs. Write, wire, or phone your nearest Gulf office today.

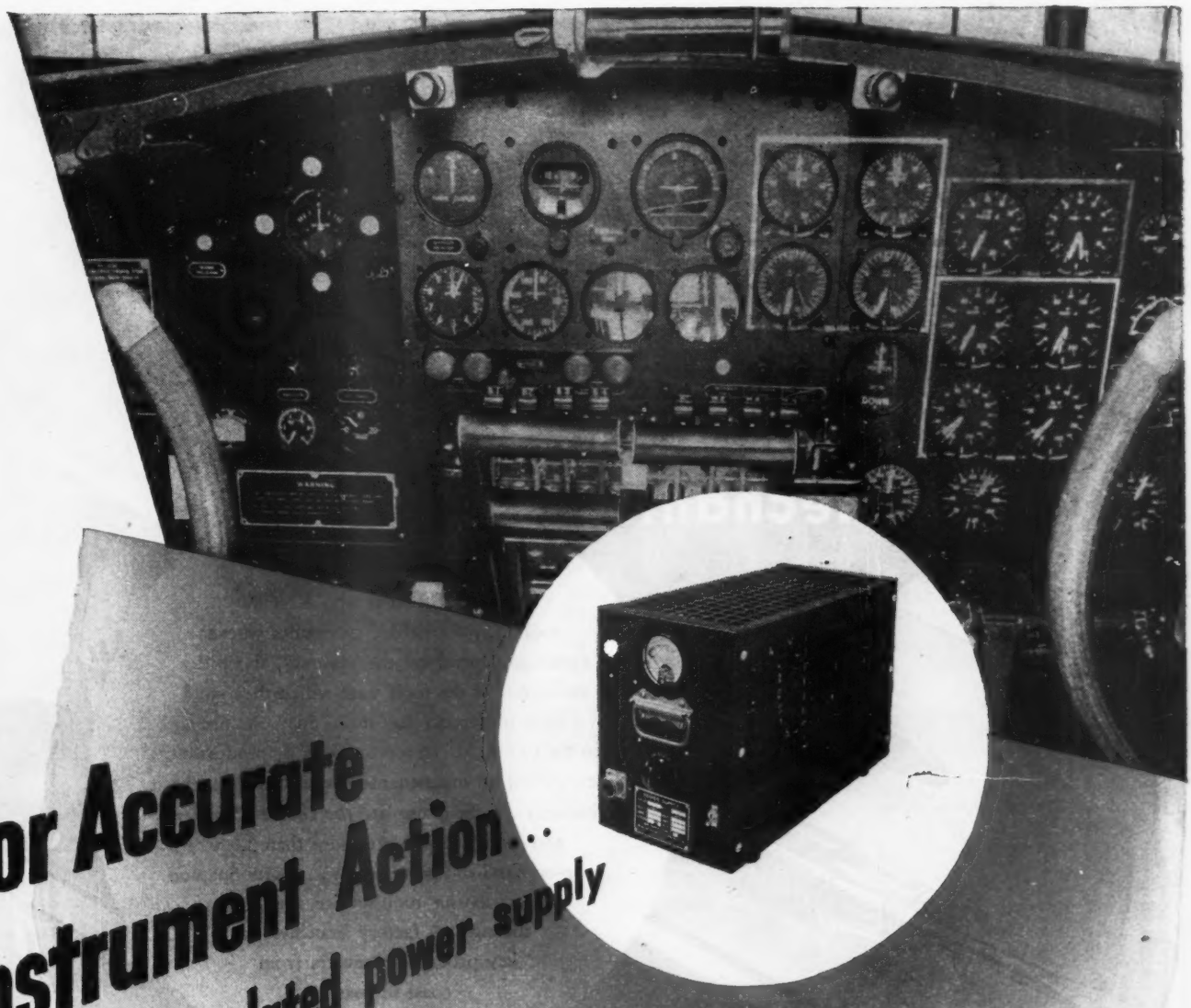
GULF INDUSTRIAL LUBRICATION

GULF OIL CORPORATION · GULF REFINING COMPANY

Division Sales Offices:

Boston · New York · Philadelphia · Pittsburgh · Atlanta

New Orleans · Houston · Louisville · Toledo



For Accurate Instrument Action... Federal's regulated power supply

Reliable aerial navigation depends upon absolute accuracy of aircraft instruments.

Constant testing of these instruments under flight conditions . . . in the air or on the ground . . . is possible with Federal's regulated-voltage power supply.

Designed to replace unwieldy storage batteries normally used for this purpose, this light-weight Federal power supply converts 115-volt alternating current into a closely-regulated, filtered direct current for the accurate testing of electrical instruments and other aircraft accessories.

This is only one of the many types of all-purpose power supply units powered by Federal Selenium Rectifiers . . . another example of Federal design and manufacturing leadership . . . and another good reason why you should *consult Federal first.*

FEDERAL TELEPHONE & RADIO — FTR

Federal Telephone and Radio Corporation

AN IT&T ASSOCIATE

Newark 1, N. J.

Snap-on Tools
The Choice of Better Mechanics
The unerring appraisal of men who KNOW tools . . . the skilled mechanics whose earnings depend on the accuracy, flexibility and speed of the tools with which they work . . . their preference has made Snap-on foremost in the tool field. In service shop or production line . . . and on maintenance operations throughout industry . . . Snap-ons are *the choice of better mechanics.* There are more than 3,000 Snap-on hand-and-power tools . . . with Snap-on direct-to-user tool service available through 38 factory branches in key production centers from coast to coast.
Snap-on Tools
FOR PRODUCTION AND MAINTENANCE

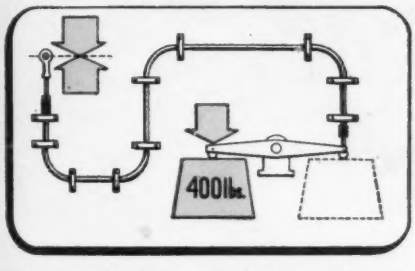
SNAP-ON TOOLS CORPORATION, 8020-L 28th Ave. • Kenosha, Wisconsin

Dependable *all around duty assured with* Simmonds Push-Pull Controls

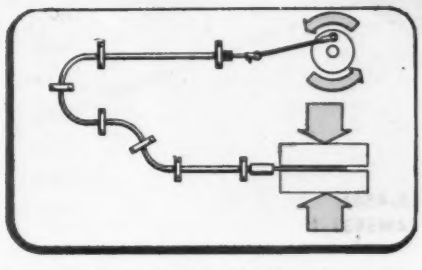
Read how these other tests, conducted to AAF specifications, show how Simmonds products more than qualify for EXTRA DUTY as well as NORMAL DUTY operations.

FIRST TO CARRY THE YELLOW DOT

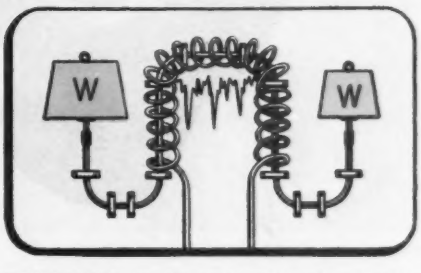
of Army Air Force Winterization acceptance for operation in extreme temperatures is the Simmonds-Corsey Push-Pull Control. Comprehensive tests with temperatures as low as minus 72°F. and as high as 160°F. prove efficient operation under wide variety of conditions.



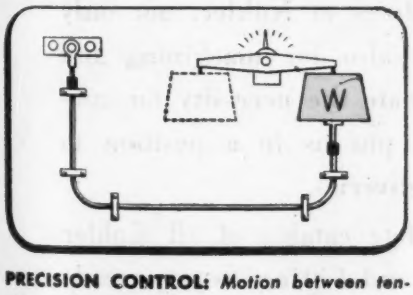
STATIC STRENGTH: *In this test Simmonds push-pull control successfully withstands tensile and compressive forces of 400 lbs. Credit simplification of design, improved linkage.*



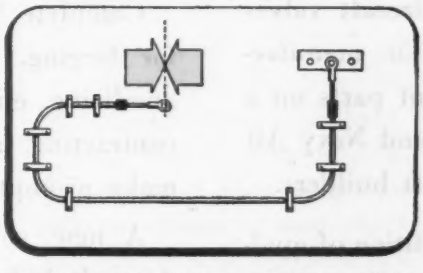
ENDURANCE: *Cycled 30,000 times under stress, as illustrated, Simmonds controls are not affected in any way, and can be expected to outlast the life of unit served.*



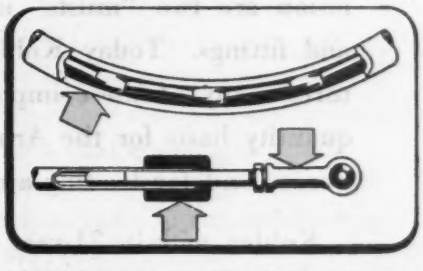
EFFICIENCY: *Input-output ratio of control is measured at various temperatures in insulated chamber. Result: average efficiencies are twice the AAF requirements.*



PRECISION CONTROL: *Motion between tension and compression is negligible. Before endurance test: average—.046"; after—.082". Simmonds are precision-built controls.*



DEFORMATION: *AAF specifications call for loads ranging from 10 to 50 lbs. Allowable average deformation is .140". Simmonds controls average only .083".*



CORROSION: *Simmonds controls meet AAF specifications for corrosion resistance with standard cadmium plated or anodized surfaces. Tube ends are rubber sealed.*

INQUIRIES concerning War Contracts or Post-War problems involving push-pull control equipment are invited. Our service engineers will furnish you gladly with analyses and recommendations. Telephone or write to your nearest Simmonds office.

SIMMONDS EQUIPMENT FLIES WITH EVERY TYPE OF ALLIED AIRCRAFT

Automatic Engine Controls — Push-Pull Controls — Spark Plugs
Hydraulic Accumulators — Hydraulic Fuses — Chronometric Radiosondes
Self-Aligning Rod-End Bearings — Fasteners and Clips of Specialized Design

30 Rockefeller Plaza,

SIMMONDS AEROCESSORIES INC.

New York 20, New York

Branch Offices: Dayton • Washington • Hollywood • Montreal

Manufacturing Plants: New York • Vermont • California

AIRCRAFT VALVES AND FITTINGS by KOHLER

K-4566
AN5831-I

DEPENDABLE quality and unerring precision are two "musts" in aircraft valves and fittings. Today Kohler Co. manufactures many of these important parts on a quantity basis for the Army and Navy Air Forces and for leading aircraft builders.

Kohler, with its 71-year tradition of quality, is well equipped to furnish the kind of workmanship required to meet rigid Army-Navy specifications. Proof that it does is the fact that Kohler manufactures aircraft valves and fittings under a Class "A" quality rating assigned by the War Department.

Complete facilities at Kohler, not only for forging, but also for machining and anodizing, eliminate the necessity for subcontracting, and put us in a position to make prompt deliveries.

A new, complete catalog of all Kohler Aircraft Valves and Fittings is now ready for distribution. Just mail a postal to Dept. A-12 for your FREE copy. Kohler Co. Established 1873. Kohler, Wisconsin.

★ BUY UNITED STATES WAR BONDS ★

KOHLER OF KOHLER

PLUMBING FIXTURES AND FITTINGS · HEATING EQUIPMENT · ELECTRIC PLANTS

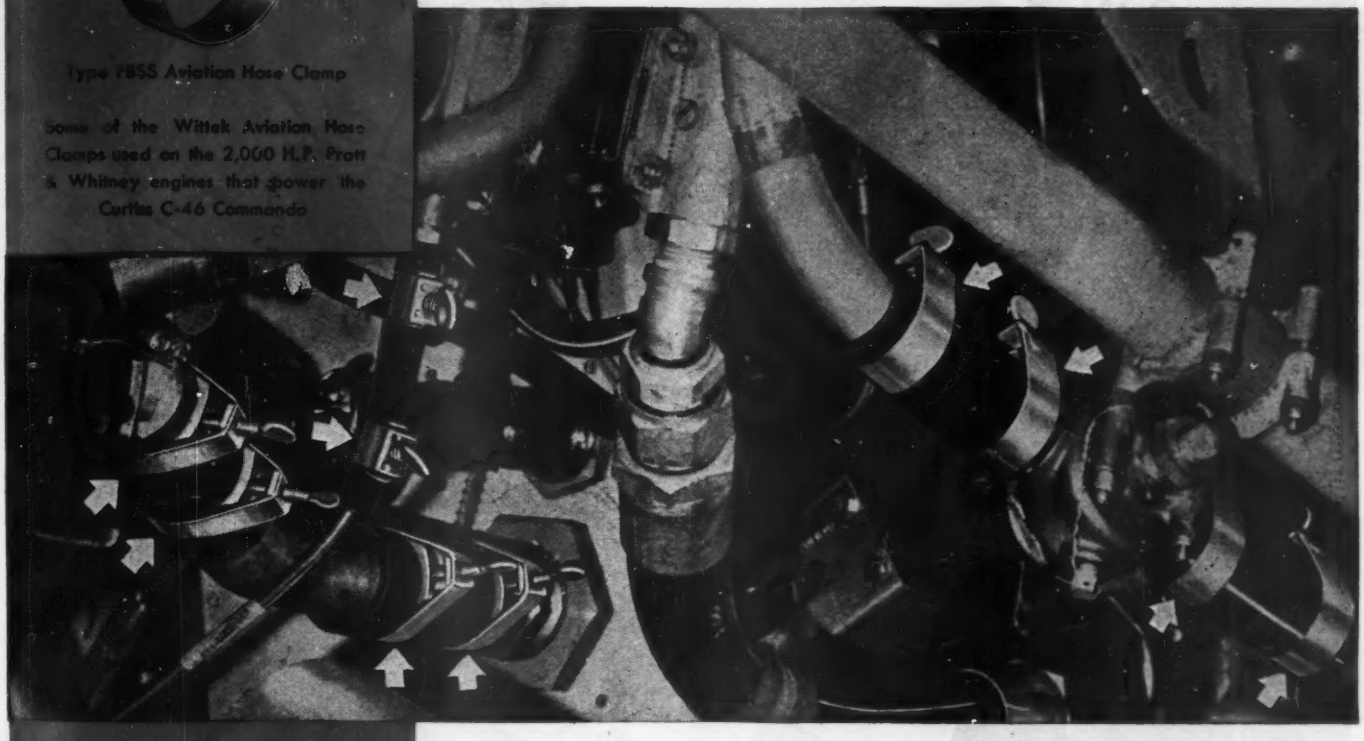
Standard in the Aviation Industry

WITTEK

Aviation Hose Clamps

Type FBSS Aviation Hose Clamp

Some of the Wittek Aviation Hose Clamps used on the 2,000 H.P. Pratt & Whitney engines that power the Curtiss C-46 Commando



Type WWD Worm Drive Aviation Hose Clamp

Wittek now offers two distinctly different aviation hose clamps complying with the requirements of specification AN-FF-C-406A.

Type FBSS—is manufactured in the standard AN-748 sizes and incorporate a bridge extender which provides uniform sealing characteristics. This is the most effective type hose clamp for all applications in which an adjustable clamp is not necessary.

Type WWD—a worm drive stainless steel hose clamp which, because of its wide range of adjustment, is the most effective clamp for uses where a clamp capable of accommodating various diameters of hose is necessary.

These two Wittek Aviation Hose Clamps are made from stainless steel, and combine the superior physical qualities of that material with the well-known Wittek qualities of superior service and high dependability. There is a Wittek Hose Clamp to meet every requirement of the Aviation Industry. Write for new descriptive catalog.

War Bonds for Victory

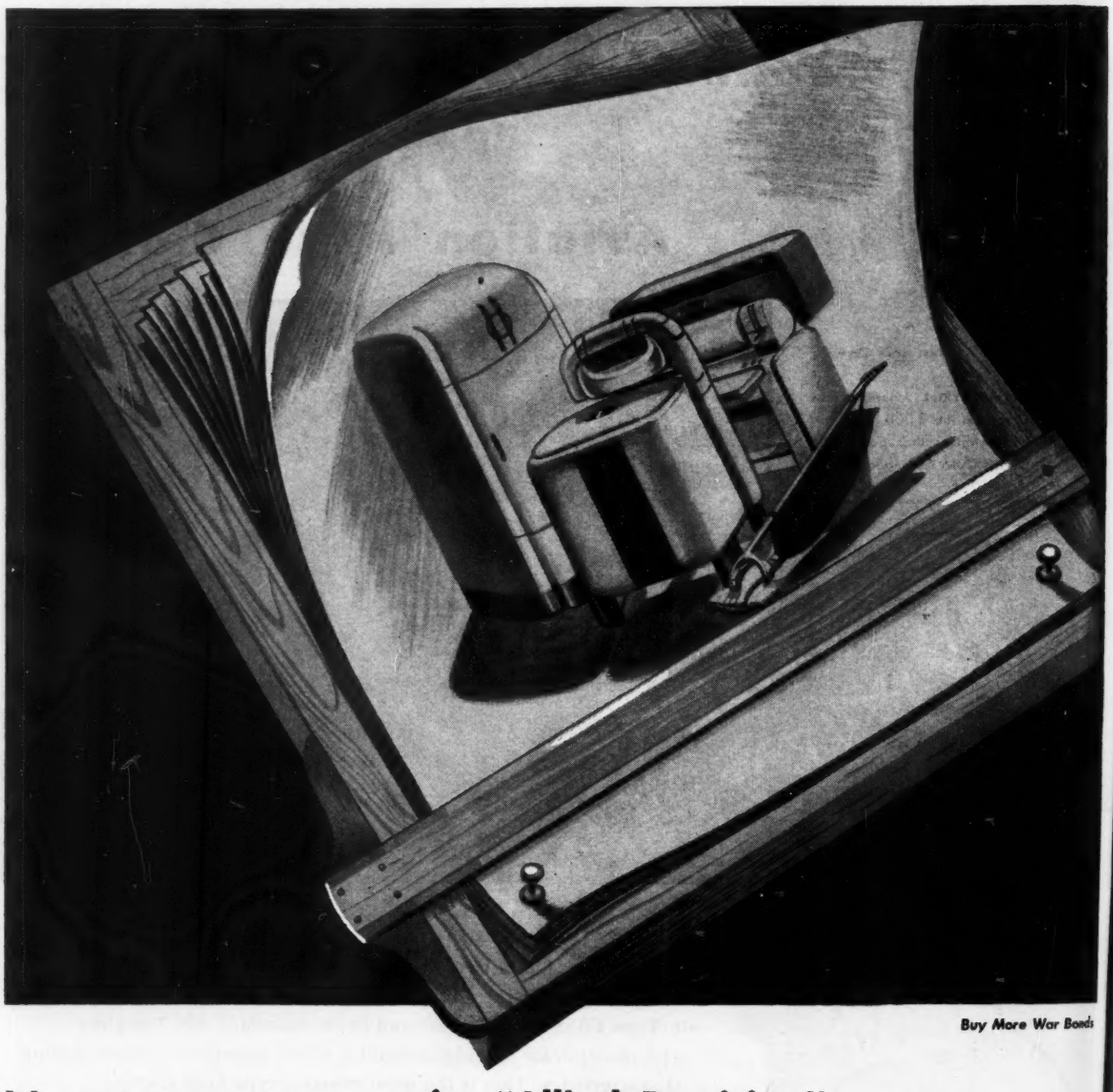
ARMY E NAVY

Buy MORE in '44

WITTEK MANUFACTURING CO.

4305-15 West 24th Place, Chicago 23, Ill.

Aviation HOSE CLAMPS WM Co.



Buy More War Bonds

It's not too soon to write "Allied Precision" into your postwar plans

Even if your postwar products are only in the drawing board stage, we want to show how Allied Products Corporation might help you *right from the start.*

For years Allied has been famous for its precisely made steam-heated plastic molds, sheet metal dies, R-B interchangeable punches and dies, and other vital production tools. Now, it has won new distinction through the excellence of millions upon millions of hardened and precision ground wartime parts. Among the varied shapes and sizes, are airplane engine and gun parts finished to within limits of two ten-thousandths of an inch.

Soon, the hundreds of skilled craftsmen responsible for Allied Precision—the amazing machinery of modern mass production—and a practical, mature business experience will be available to the producers of peacetime goods. Here is a "pool of precision" for manufacturers seeking a dependable, economical source of outstanding tools and parts. Won't you write us today?

"IT'S AN ALLIED PRODUCT" . . . Allied Products Corporation and its divisions, Richard Brothers and Victor-Peninsular, in Detroit and Hillsdale, Michigan, also make: Jigs and fixtures, cold forged parts, cap screws and other special products.

ALLIED PRODUCTS

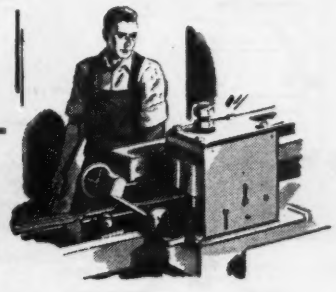
CORPORATION

Department 16, 4614 Lawton Avenue, Detroit 8, Michigan

Thinking about reconversion?...

Reconversion may mean headaches to many engineers and production men. To you who are thinking about these problems now, consider industry's new production tools—the applications of electronic tubes and what they are doing today.

FOR EXAMPLE...



a midwestern manufacturer of heavy equipment saves $15. a ton in hardening steel bars by electronic control . . . a saving of 50% over conventional methods.

FOR EXAMPLE...

in another plant, shells are accepted or rejected electronically, eight different tests for accuracy completed in split seconds, at a rate of one shell a second.

FOR EXAMPLE...

a maker of hand grenade fuses prevents disastrous and costly explosions by checking the exactness of the powder charge with electronic tubes.

The profitable application of electronic tubes is legion. A look around your plant may disclose ways to save you worry, get increased production and create more profits. It may be in electronic induction or dielectric heating, in welding control, in motor speed control, in inspection, in counting, sorting, weighing. Can you save money or not by putting electronics to work? If you have a hunch about an operation of this kind and need help, let us know. Write Westinghouse Electric & Manufacturing Co., Lamp Division, Bloomfield, New Jersey.

Westinghouse

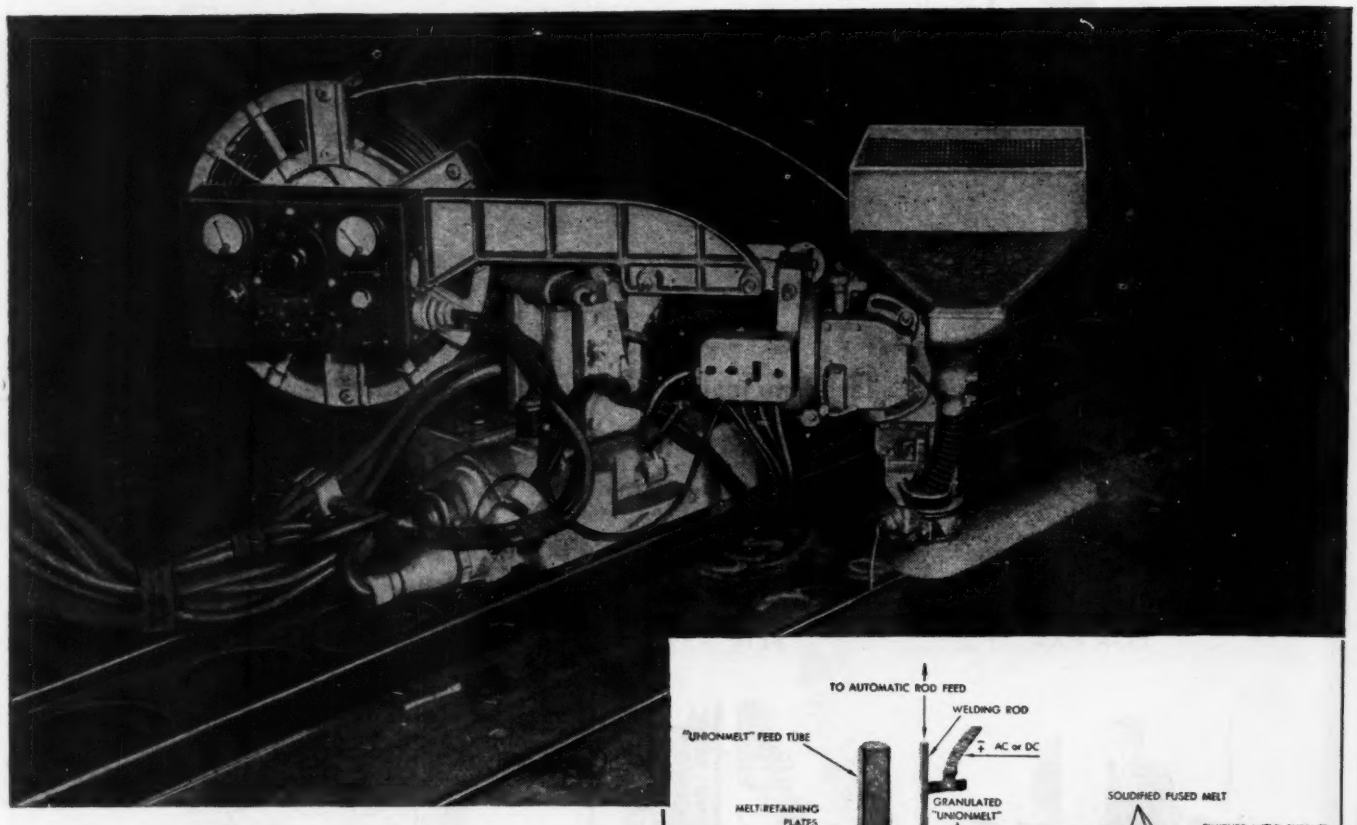
PLANTS IN 25 CITIES OFFICES EVERYWHERE

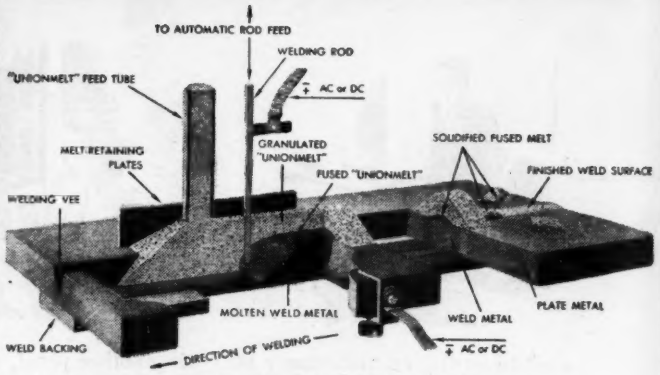
Quality Controlled Electronic Tubes

For industrial tube replacements, remember you can get quick local service from your nearest Westinghouse distributor.

WESTINGHOUSE PRESENTS John Charles Thomas • Sunday 2:30 EWT., N.B.C. ★ Ted Malone • Monday, Wednesday, Friday—10:15 EWT—Blue Network.

UNIONMELT WELDING





Linde's Automatic Electric Process

UNIONMELT electric welding joins steel of any commercially used thickness at speeds up to twenty times faster than similarly applicable methods. Because the process is automatic, it produces uniform welds of unusually high-quality with minimum dependence on the manual skill of welding operators.

The flexibility of UNIONMELT welding has led to its application for a wide variety of work—for heavy and light material, for repetitive operations or single jobs, and for shape-welding as well as for straight-line and circumferential welding.

Metal-fabricating shops of all kinds can profit by using the UNIONMELT process for either fabrication or repair work. If you are interested in learning more about this process, or in discussing its possibilities for any particular application, please write to us.

BUY UNITED STATES WAR BONDS

HOW IT WORKS

1. A special granulated material known as UNIONMELT is laid down along the seam to be welded so that it covers the end of the welding rod.

2. Heat, generated by passing an electric current through the UNIONMELT composition between the welding rod and the parts being welded, progressively melts some of the UNIONMELT so that it forms a protective blanket over the weld area.

3. Underneath this molten UNIONMELT composition, metal from the rod and from the plate edges are fused to form the weld.

4. The molten UNIONMELT cools and solidifies behind the welding zone and, on further cooling, contracts and detaches itself.

The process of welding electrically beneath a mineral melt by the method illustrated is patented.

The Linde Air Products Company
Unit of Union Carbide and Carbon Corporation
UCC
General Office, 30 E. 42nd St., New York 17, N. Y.
Offices in Other Principal Cities
In Canada: Dominion Oxygen Company, Limited, Toronto

LINDE OXYGEN . . . PREST-O-LITE ACETYLENE . . . UNION CARBIDE
OXWELD, PUROX, PREST-O-WELD, UNIONMELT APPARATUS
OXWELD AND UNIONMELT SUPPLIES

The word "Unionmelt" is a registered trade-mark of The Linde Air Products Company

Self-Acting Variable Pitch Propeller Means Wider Horizons for Private Flyers

Thanks to the unique Aeromatic Propeller, private flyers of tomorrow will have "new wings" . . . wider horizons. With Aeromatic, you can use shorter fields or strips for takeoff or landing . . . cruise farther and faster per gallon of fuel. That means greater range . . . more places to come from and go to . . . more get-up . . . more go . . . more fun.

Aeromatic gives you those things by giving you variable-pitch performance every foot of the way . . . and giving it automatically. At all times, from start of your take-off run to the end of your landing run, Aeromatic knifes through the air with just the right pitch or size of bite . . . gives you peak engine performance with each revolution.

Completely self-contained and self-acting, controlled by natural forces, Aeromatic Propeller requires no instruments . . . no controls . . . nothing additional for the pilot to watch or do. Used today for military aircraft from 100 to 450 HP, Aeromatic will soon be available for your private plane. Meanwhile, engineering and performance data are available to you and to manufacturers. Don't hesitate to write.

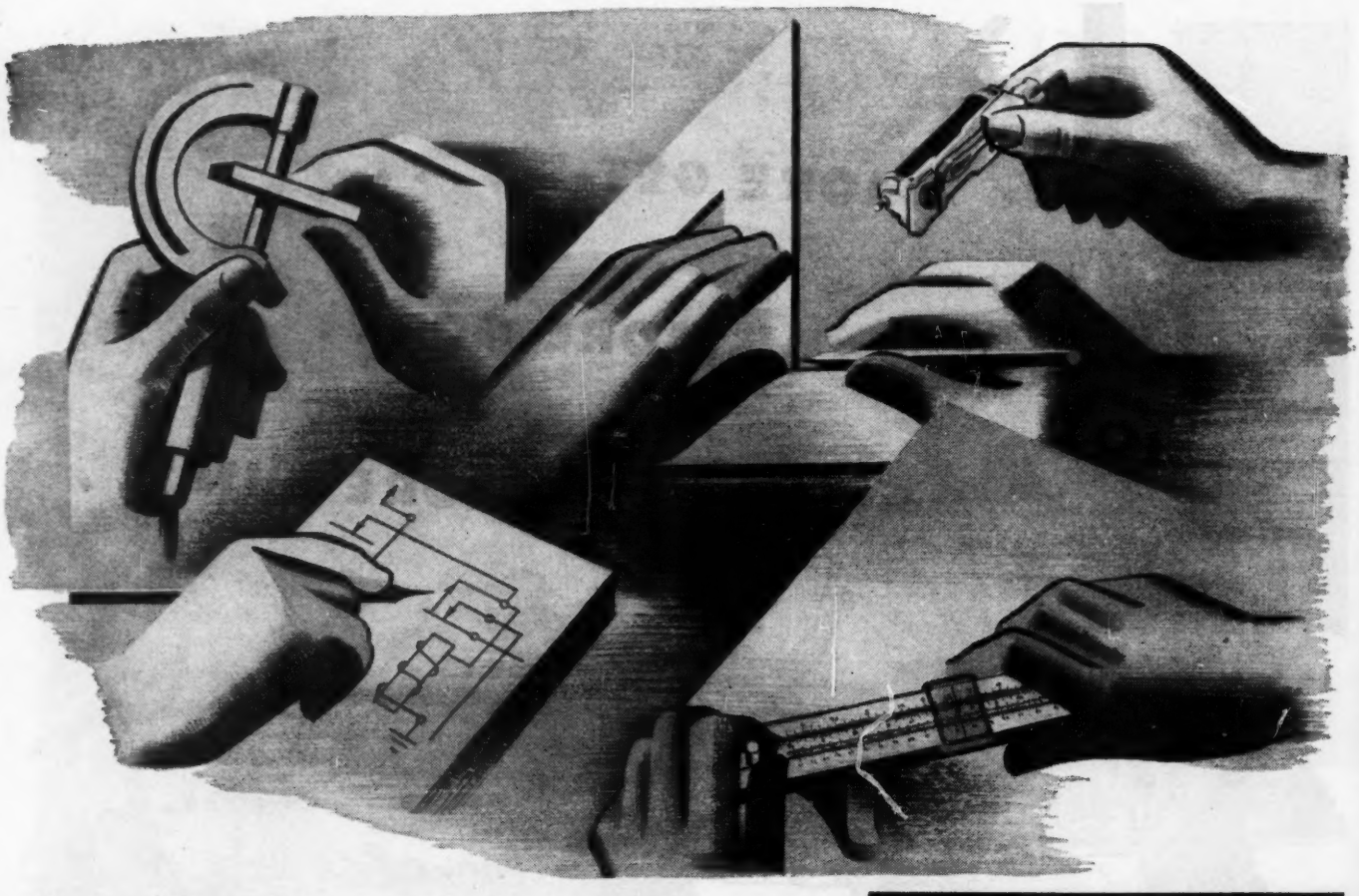
The Propeller with a Brain for Tomorrow's Plane

Aeromatic

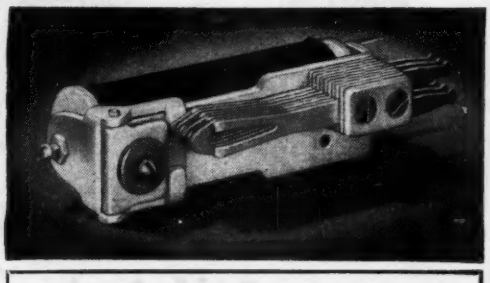
Air Controlled *Automatic Propeller*

Licensed under patents of EVEREL Propeller Corporation

KOPPERS Co., Inc., Bartlett Hayward Division, Baltimore 3, Md.



Your New Product may need the Magic of Electrical Control



TAKE another look at that new product your designers are planning. It may be that Automatic Electric control devices can make it function better—at lower cost. It's worth checking into.

To help designers perfect new developments—or improve old ones—Automatic Electric offers this unique three-point service:

1. Technical advice by experienced field engineers, who know the "how" and "why" of control technique.
2. A complete range of relays, stepping switches, and other control units—time-proved products readily adapted to your needs.
3. A design and manufacturing service for complete engineered assemblies.

Ask our field engineer for a copy of our catalog of control devices. He will be glad to show you how they can serve you.

Here are jobs that can be done easier and better with Automatic Electric control devices:

Automatic Selection and Switching of Circuits • Time, Temperature and Sequence Control • Counting and Totalizing • Inspection and Sorting Operations • All Types of Electrical and Electronic Control.

Relays
AND OTHER CONTROL DEVICES
by **AUTOMATIC ELECTRIC**

AUTOMATIC ELECTRIC SALES CORPORATION
1033 West Van Buren Street • Chicago 7, Illinois

In Canada: Automatic Electric (Canada) Limited, Toronto

PARTS AND ASSEMBLIES FOR EVERY ELECTRICAL CONTROL NEED

POUR IT ON!

Service Heavy Duty ForgeWelds *Can take it*

Heavy duty hauling calls for heavy duty casters—super-strength casters like Service "Bruisers." Here tough steel, the finest bearings and sound design are combined into casters that will stand day after day of rough and tumble service. A set of four under trucks and trailers will handle 16,000 lb. loads.

ForgeWeld Heavy Duty Bruisers are one of a complete line of casters for every industrial need.

See Our Display at NEW YORK POWER SHOW Madison Square Gardens Nov. 27 to Dec. 2

Top plate and King bolt forged from single piece of SAE-1048 steel • Double ball race swivel in machined raceways of 230 Brinell • Hyatt or Timken roller bearings • Wheels of iron, steel, molded plastic, or rubber.

SERVICE

SERVICE CASTER & TRUCK DIVISION
OF DOMESTIC INDUSTRIES, INC.
505 N. Brownswood Avenue, Albion, Michigan
Eastern Factory: 434 Somerville Ave., Somerville (Boston) Mass.
Toronto, Canada: United Steel Corporation, Ltd., SC&T Co. Division

TRUCKS, CASTERS AND SPECIALLY DESIGNED LIFTING AND HAULING UNITS

Write, wire or phone for bulletins.

Drafto

METAL DISINTEGRATOR

A REVOLUTIONARY METHOD FOR REMOVING EMBEDDED TOOLS

DRAFTO'S SIMPLIFIED DESIGN AND OPERATION MEAN QUICKER REMOVAL OF EMBEDDED TOOLS—WHERE AND WHEN NEEDED

Save

TIME

MATERIAL

MONEY

Removal of embedded tools by Drafto's "vibrating arc" principle preserves delicate threads and contours in dies and production pieces—saves work that formerly had to be scrapped. The Drafto Disintegrator is compact, portable, easily handled. Disintegrator head operates in any position. Anyone can use it. Engineering representatives will demonstrate, in your own plant—on your materials.

... $295.00

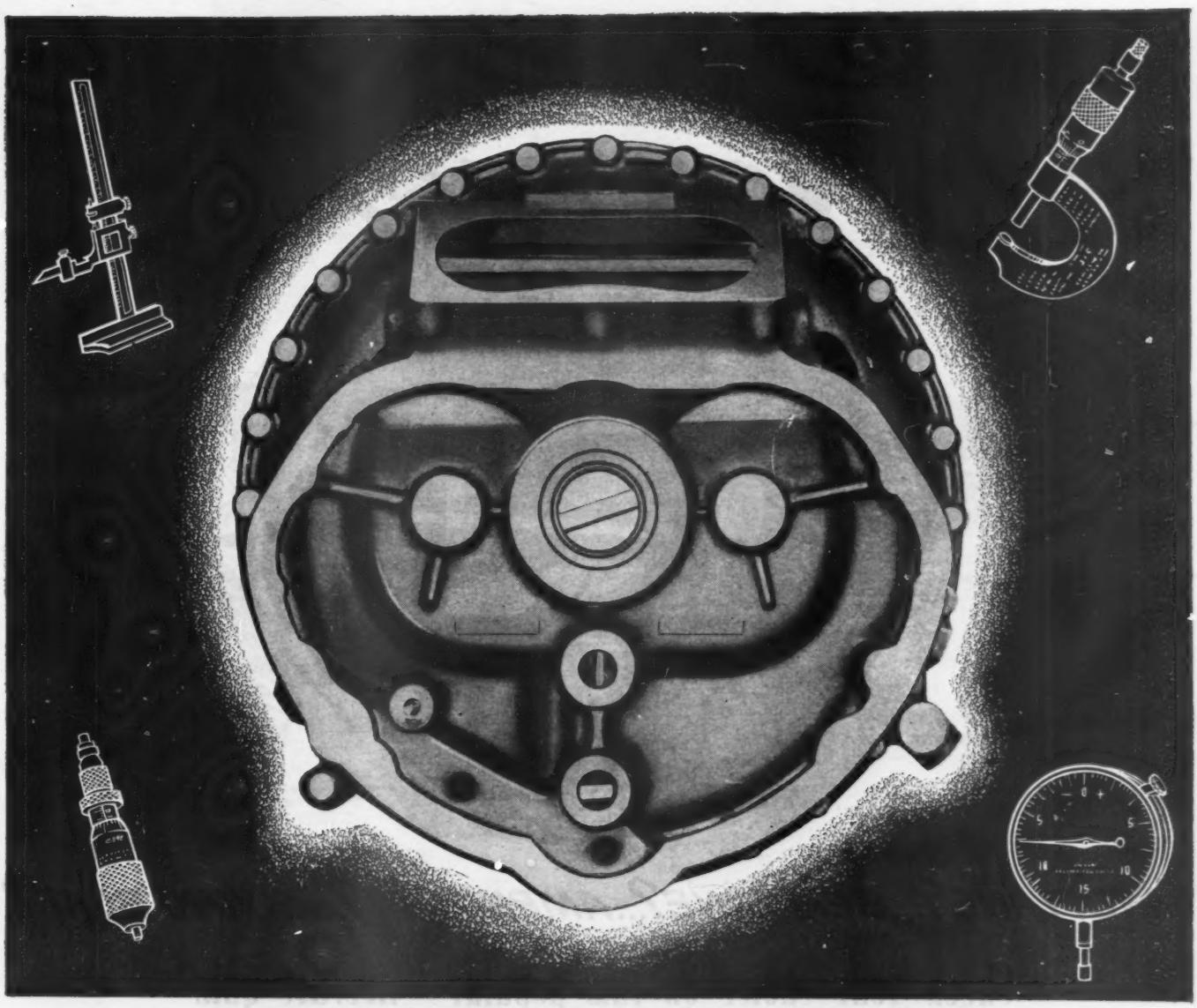
DRAFTO CORPORATION

1938 WALNUT STREET

COCHRANTON, PENNSYLVANIA

Telephone Cochranton 30

Representatives in key cities



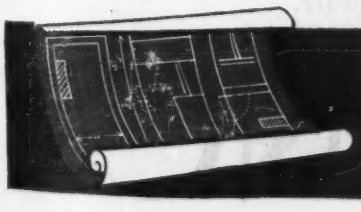
Buffalo Precision Patterns

Pictured is another intricate casting made from a Buffalo Precision Pattern.

As an integral part of one of America's most famous fighter plane engines, this casting *must* be dimensionally accurate to within one-thousandth of an inch and *must* measure up to the strictest requirements for metallurgical soundness.

At Buffalo Pattern Works, we have been specializing in precision patterns for over half a century. Our skill and wide experience with metals, structural design and practical fabrication are sound reasons why we have been privileged to develop extremely difficult patterns for many of America's leading companies.

We invite you to consult us concerning your present or post-war pattern problems. Get the benefits of "Buffalo" precision. Write or wire Dept. B today for complete information.



BUFFALO PATTERN WORKS

830 Hertel Ave. Buffalo 16, N. Y.

What TYPE peacetime plane WILL YOU FLY?

LANDPLANE?...SEAPLANE?...AMPHIBIAN?...FLYING BOAT?

Check your choice on this popular "Aircraft Quiz"

PICTURE yourself (after the war) on a seaplane holiday trip to your favorite lake—trout for breakfast—far from the crowded highways—back to nature at 150 or 200 mph, spending your time on solid enjoyment instead of creeping through the traffic lanes! Or perhaps you're thinking of a nice little amphibian, or a neat twin-engined cabin plane to set down like a thistle on wheels!

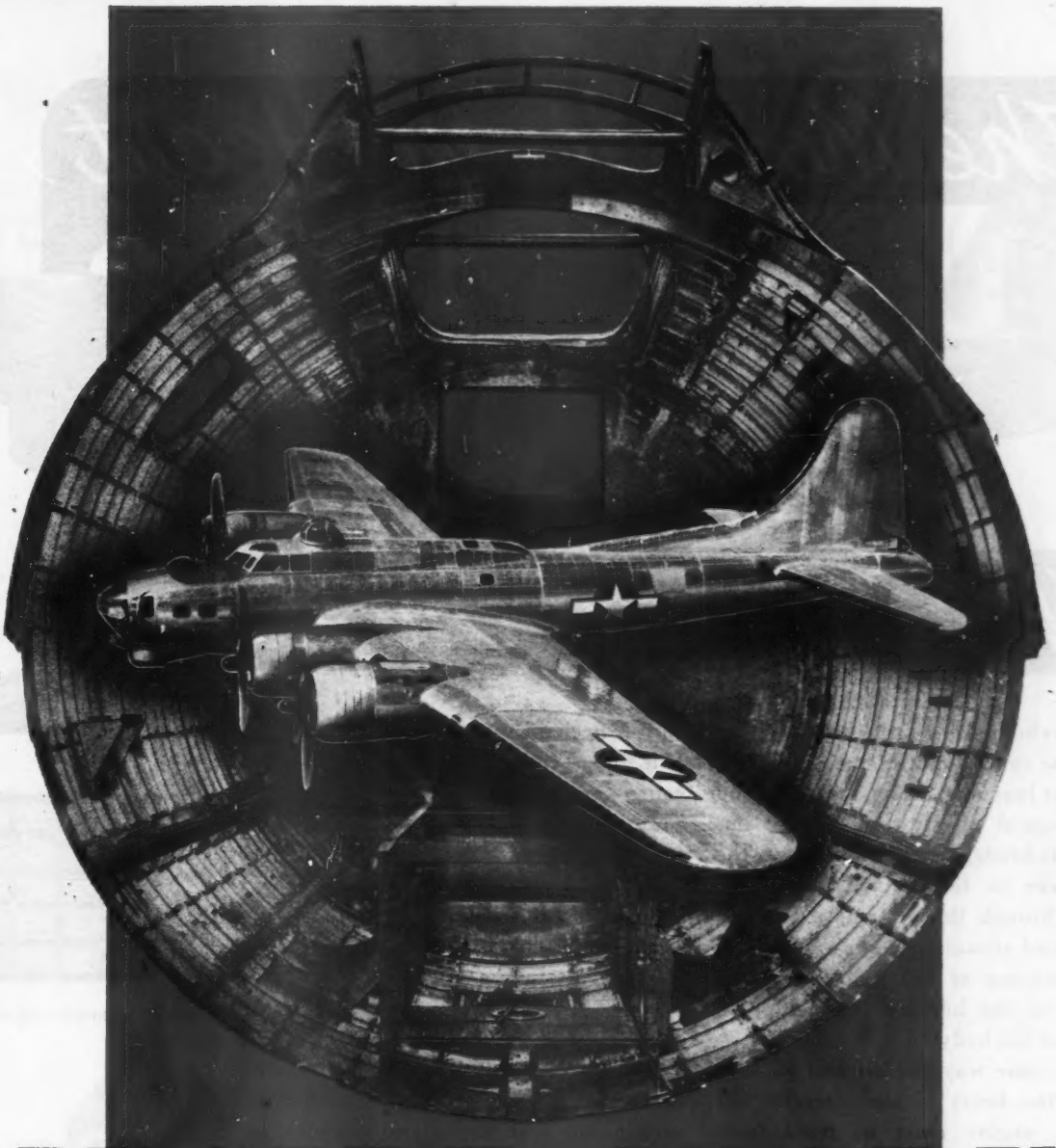
When you come to Question 14 on the provocative Bellanca Aircraft Quiz you'll find seven different types of aircraft to choose from and check, with room to write in more. Question 15 reads, "How will your post-war plane be *used?*" Here nine answers invite your study, and you can list four additional uses. These and many other Quiz questions have started thousands of Americans *thinking* ...and they help straighten out your thoughts on the *one* plane that will serve you with most satisfaction and greatest economy.

Bellanca engineering will have a bearing on that item of economy, too. Builders of outstanding aircraft since the first Bellanca cabin plane flew non-stop from New York to Berlin in 1927, Bellanca engineers are now giving their best efforts to winning the Victory with precision-built warplane armaments and components. But they're planning to convert all this skill and experience to *your* post-war plane, too—and they'll welcome *your* ideas!

We want you to be among the many who are filling out this purposeful and constructive Aircraft Quiz. It's free, you know—and in addition we'll send you later our report summarizing all the answers! The Quiz covers engines, range, speeds, construction, wings, landing gear, controls, props, capacity, and other aircraft features. Just send your name and address—get the Quiz by return mail!...Bellanca Aircraft Corporation, Dept. **S-3,** New Castle, Delaware.

★ KEEP ON BUYING U.S. WAR BONDS

BELLANCA



"INSIDE STORY"

In building the B-17 Flying Fortress, Lockheed selected Interstate to build the Fuselage Section (Station 5 to 6) pictured here.

This assignment illustrates Interstate's ability to adapt itself to the diversified requirements of modern aircraft. Whether it's a small, finely engineered precision mechanism or a large structural unit of sheet metal . . . Interstate has the men, machines and seasoned skill to produce it.

Interstate

AIRCRAFT AND ENGINEERING CORPORATION • EL SEGUNDO, CALIFORNIA

The Motor is the Heart

The Filter is the Lung

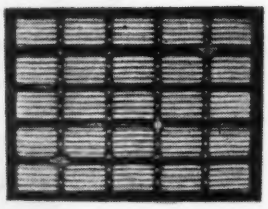
AS everybody knows the human heart is the control motor through which, in popular language, every drop of blood (often clogged up with waste and impurities) is brought into contact with the lungs there to be purified and recirculated through the system to energise muscles and stimulate nerves. This constant purifying of the blood-stream is essential to the healthy functioning of all parts of the body.

In the same way the air and oil that "feed" the heart of the aircraft—the motor or engine must be freed from impurities to ensure maximum reliable performance. Vokes Filters are the lungs which ensure clean air and clean oil being delivered where it is required. They clean *all* the air and *all* the oil *all* the time keeping up a sustained filtration efficiency of 99.9 per cent. of all dust particles to 0.00004 in diameter.

Vokes Air and Oil Filters are fitted to aircraft flown in all battle areas by the R.A.F., also Dominion and American Air Forces. Not only do Vokes Filters service all types of engine, radial or in line, but they are also used for gun turret mechanism and hydraulic retractable undercarriages. Vokes Filters are of course used on test-bed equipment in the world's most famous aero-engine producing works.

American engineers have for a long time adopted Vokes Air, Oil and Fuel Filters in many forms of industry—to mention one particularly—the provision of filters for tractors operating usually in conditions where dust and sand storms are a perpetual menace. As on the battle fields where sand played such havoc with tanks and tractors, so in agriculture Vokes Filters with their easily cleanable or replaceable parts prove invaluable.

Vokes have actually produced over 3,000 models of their various filters and supply the necessary housing and ductings to secure sustained maximum filtration efficiency. Vokes are ready to produce any type of Air, Oil or Fuel Filter to any size or capacity for any industry. It will surely pay you to consult and co-operate with the firm who are original pioneers and specialists in this vitally important work.



VOKES AEROVEE FILTER ELEMENT

VOKES HIGH PRESSURE OIL FILTER

VOKES OIL FILTER FOR AIRCRAFT

VOKES FILTRATION & SILENCING CO. INCORPORATED, 101, Park Avenue, New York, & VOKES (CANADA) LTD., 1123, Bay Street, Toronto, Canada.
Contractors to British and Dominion Governments.

VOKES FLAME TRAP SILENCER FOR AIRCRAFT

VOKES · LIMITED · LONDON · S·W·

DESIGNERS, PATENTEES & MANUFACTURERS OF AIR, OIL & FUEL FILTERS & SILENCERS

HOW TO CUT THREADS IN THE NEW AGE

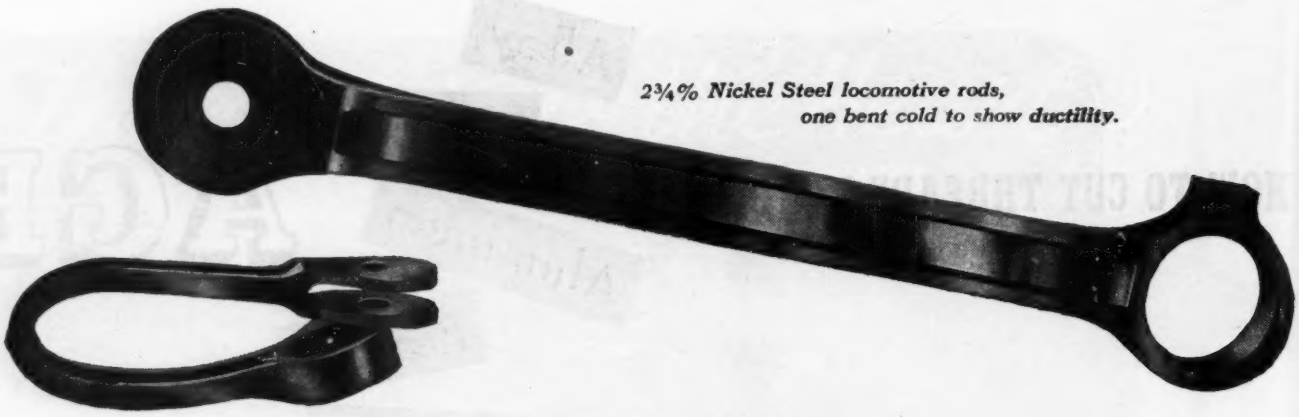
ARE YOU PLANNING TO USE NEW MATERIALS AFTER THE WAR?

Experimenting in the threading of materials that are new to you can be an expensive, time-wasting process.

Magnesium, aluminum, various plastics, and other materials which are being used more and more widely require individual threading shop practices. The Greenfield Tap and Die Corporation has had wide experience in threading all kinds of materials and is ready to help you select—quickly and efficiently—the proper threading tool and gaging setup for your product.

SIMPLY CALL "THE GREENFIELD MAN"—THROUGH YOUR GREENFIELD DISTRIBUTOR.

GREENFIELD TAP and DIE CORPORATION · Greenfield, Massachusetts



2¾% Nickel Steel locomotive rods, one bent cold to show ductility.

QUENCHED AND TEMPERED

NICKEL STEEL

FORGINGS COMBINE

EXCEPTIONAL DUCTILITY WITH HIGH TENSILE STRENGTH

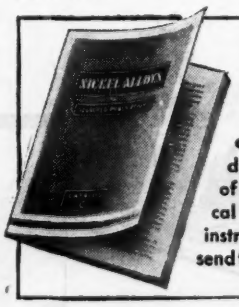
Composition and Typical Properties of Normalized Quenched and Tempered 2¾% Nickel Steel Rods

Description or Size	Melt Yield Pt. No. #s per Sq. In.	Tensile Strength #s per Sq. In.	Elong. % in 2 In.	Reduction in Area %	ANALYSIS					
					Car.	Mang.	Phos.	Sul.	Sil.	Ni
Main Rod....	92900	110000	25.0	64.4	.31	.78	.027	.026	.25	2.75
Main Rod....	86500	104500	25.5	65.6	.32	.86	.034	.032	.29	2.69
Main Rod....	86360	104400	26.0	64.8	.32	.86	.034	.032	.29	2.69
Main Rod....	87850	102350	26.0	66.2	.31	.89	.037	.025	.32	2.69
Front Rod....	86000	102250	25.0	67.3	.29	.82	.035	.027	.24	2.71
Front Rod....	83900	104250	25.0	66.1	.29	.82	.035	.027	.24	2.71
Front Rod....	86850	104250	27.0	66.1	.32	.86	.035	.025	.30	2.65
Front Rod....	89500	107050	25.5	65.6	.32	.86	.035	.025	.30	2.65
Back Rod....	89500	107650	25.0	62.7	.30	.79	.030	.025	.22	2.71
Back Rod....	87500	106450	25.0	65.4	.29	.82	.035	.027	.24	2.71
Back Rod....	87000	105600	25.0	65.4	.29	.82	.035	.027	.24	2.71
Back Rod....	88150	104850	26.0	66.8	.29	.82	.035	.027	.24	2.71

Specimens Taken from Mid-Section of Prolongations of the Forgings

The above table compiled by the American Locomotive Company shows the chemical compositions and mechanical properties of some normalized, quenched and tempered nickel steel front, main and back rods recently produced as replacement rods for locomotives being speeded up and rebalanced. These values are typical of replacement rod forgings recently tested by that company.

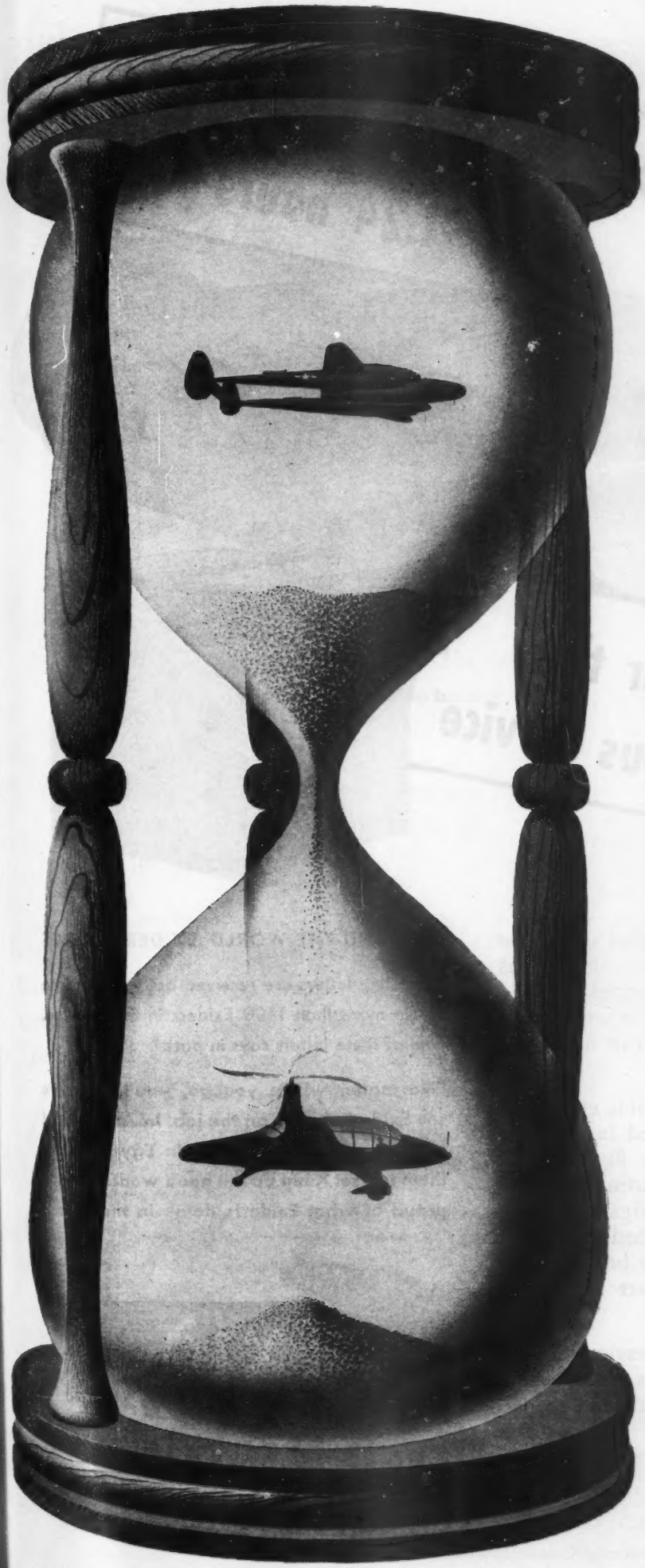
Quenched and tempered nickel steel forgings provide high tensile strength and ductility, combined with unusual toughness and high fatigue strength—qualities which tend to obviate breakage and assure long, trouble-free service when employed in heavy duty machinery and equipment.



Catalog "C" makes it easy for you to get booklets and bulletins on industrial applications of Nickel, metallurgical data and working instructions. Why not send for your copy today?

★ Nickel ★

THE INTERNATIONAL NICKEL COMPANY, INC., *67 Wall Street, New York 5, N. Y.*



Every MANUFACTURING CUSTOMER Will Benefit

Industrial users of WILCO Products will find the increased facilities, the new products and techniques developed by WILCO for war service of great advantage to their own postwar products.

As the Hourglass indicates . . . with the coming of peace, many WILCO products now making for precision performance in airplanes, ships, tanks, guns and instruments of the Army and Navy will play an equally important role in meeting civilian needs for hundreds of useful and reliable products.

The demand of all branches of the service for Thermostatic Bimetals and Electrical Contacts has motivated many WILCO developments of great potential value to postwar industry. New products added to an already extensive line; increased facilities for refining and fabricating precious metals; greatly extended rolling mill facilities—these new additions and improvements, now devoted principally to the war effort, will prove equally helpful to manufacturing customers in meeting their peacetime production and marketing problems.

WILCO PRODUCTS ARE: *Contacts*—Silver, Platinum, Tungsten, Alloys, Sintered Powder Metal. *Thermostatic Metal*—High and Low Temperature with new high temperature deflection rates. *Precious Metal Collector Rings* for rotating controls. Silver Clad Steel. *Jacketed Wire*—Silver on Steel, Copper, Invar, or other combinations requested. Rolled Gold Plate. Special materials.

THE H. A. WILSON COMPANY
105 Chestnut Street, Newark 5, New Jersey

Branches: Detroit • Chicago

WILCO

Thermometals—Electrical Contacts
Precious Metal Bimetallic Products

WHEN Howard R. Hughes set a new round-the-world record in 1938, he clipped the previous record to less than half. And he experienced the odd sensation of apparently gaining on time. For on Hughes' big silver monoplane the sun set and rose five times during the four days' flight.

This was also the fastest round-the-world ride ever taken by Exide Batteries, which have been used in so many history-making flights. On the Hughes flight, Exide Aircraft type batteries were used for starting, and for furnishing current for landing lights, navigation lights, and instrument lights. They also furnished the major portion of current requirements for radio broadcasting, and were in reserve for emergency power in case of generator failure.

Today, Exide Aircraft Batteries are in daily service throughout the world on our mighty bombers, hard-hitting fighters and other aircraft. Pilots, engineers, and ground crews have learned from many successful missions that they can always count on Exides for dependability, long-life, and ease of maintenance.

A ROUND-THE-WORLD EXIDER WRITES

Interesting letters are received daily from some of the more than 1400 Exiders in the Service. One of these letters says in part:

"No matter where you go, you'll always see Exide Batteries on the job. In Australia I saw them advertised, and in Egypt I saw them in use. Keep up the good work. We are proud of what Exide is doing in the war."

ARMY E NAVY

Exide
AIRCRAFT
BATTERIES

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia 32

Exide Batteries of Canada, Limited, Toronto

News for Aviation

HYDRAULIC KwiKloZ VALVE

Single Seat Balanced Shut-off Valve—Never Affected By Back Pressure Whether Open or Closed

▶ Typical A-P Control development for the aircraft industry, the KwiKloz Valve offers new advantages in hydraulic testing systems and aircraft hydraulic system lines. A balanced valve, with a *single* seat, it permits easy and INSTANTANEOUS closing against a maximum pressure of 1500 lbs. p. s. i.

▶ It is more efficient, has fewer parts, is smaller, lighter, and uses less material. Can be quickly changed for clockwise or counter-clockwise operation. Corrosion resistant parts, heat treated, ground, and accurately polished. Outside dimension, 2½" x 2⅞" x1¼"; made to take connections per AND-10050 specifications or pipe tap.

For KwiKloz Bulletin and Catalog of A-P Aircraft Controls . . . check and return this coupon . . .

Please send me the following:

☐ Bulletin on A-P Hydraulic KwiKloz Valve

☐ Catalog on A-P Aircraft Controls

Firm_____

Address_____

City_____ State_____

Attention of_____

HYDRAULIC KwiKloZ VALVE

AIRCRAFT DIVISION

AUTOMATIC PRODUCTS COMPANY

2484 North Thirty-Second Street • Milwaukee 10, Wisconsin

for Peace and Good Will

To buy War Bonds—*Victory Bonds*—is the duty of every peace-loving American. In that way he gives a practical Christmas Gift . . . a guarantee to the entire world . . . for Peace and Good Will.

U S super-positive

For Ring Conditions Favoring Peak Performance . . .

Use U. S. Super-Positives

U. S. HAMMERED PISTON RING CO., INC.

STIRLING, NEW JERSEY, U. S. A.

New! STRONGHOLD SCREW PRODUCTS

HEX-SCRO

An Improved "STRONGHOLD" Multi-Use Multi-Drive Fastener

NO SPECIAL TOOLS REQUIRED

AN and AC
70
302
340
345
350
380
385
500
500A
501
501A
504
505
506
507
510
515
520
526
530
531
535
540
545
550
560
565
566
935
936
940
945
960
970

A SLEEK new product that has many outstanding mechanical and use advantages over ordinary machine screws—little brother to the matchless STRONGHOLD cap screw.

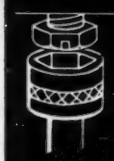
- Cold forged, free from internal stress and strain.
- Thread points are machine chamfered for easy starting.
- Heads are trimmed to close tolerances; sharp corners of heads assure longer tool life.
- Heads chamfered with washer face underneath.
- Ideally suited for power or hand tool application; can be driven at any driving angle without damage to screw head.
- Will stand tremendous amount of driving torque without damage to head.
- Easily accessible from either top or side in hard-to-reach places.
- Machine screws and set screws made in lengths from ¼" to 1½"; diameters, No. 6, 8, 10, 12; coarse or fine thread.

Ask for Free Samples

MANUFACTURERS SCREW PRODUCTS

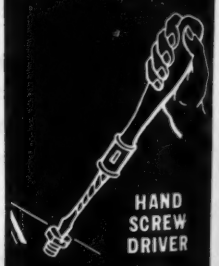
204 WEST HUBBARD STREET
CHICAGO 10, ILLINOIS
PHONE—WHITEHALL 4680

BOX WRENCH OR OPEN WRENCH



SOCKET WRENCH

POWER SCREW DRIVER



HAND SCREW DRIVER

HARD-TO-REACH PLACES EASILY ACCESSIBLE

Delco-Remy
Aircraft Electrical Equipment

Over coastline, forest country and plains, auxiliary "eyes" of the armed forces peer earthward—eyes of the Civil Air Patrol. The job they are doing is an unselfish routine of volunteer air hours, tedious tasks, courier service and assembly maneuvers . . . essential to national security, and contributing much to the progress of aviation in years to come.

More than half of Delco-Remy's facilities are now engaged in the manufacture of electrical units, precision parts and products for the aircraft industry. The efficiency and dependability of Delco-Remy electrical equipment in military planes of all types qualify it for service in cargo ships, airliners and the private planes of the future.

ARMY E NAVY

DELCO-REMY

WAR BONDS WILL BRING THEM HOME SOONER

DIVISION, GENERAL MOTORS CORPORATION

THE *only* REPRODUCTION PAPERS WITH AN *anti-diffusion* EMULSION

Diffusion results when light waves are deflected by particles of silver salt in the emulsion or by the surface of the paper
The Photo-Arc emulsion absorbs the deflected light waves so close to their points of origin that diffusion is closely controlled

Light-diffusion closes up lines in a negative, spreads them in a positive print. It causes poor definition, lost details, fuzziness. In the past, diffusion could be avoided only by achieving exactly the right exposure.

The new Photo-Arc emulsion reduces diffusion — reduces it so decidedly that full, non-critical exposures can be made. Lines are clean and sharp. Greater density, greater contrast, greater legibility are assured.

PEERLESS PHOTO-ARC REPRODUCTION PAPERS

The *only* silver emulsion reproduction papers which can be handled and processed without dimming lights

The *only* such papers which can be run in *any* kind of continuous blueprint machine

Send for literature giving full information

Manufactured only by

PEERLESS PHOTO PRODUCTS, INC.

Dept. 12b, 50 Broadway, New York 4, N. Y.

Rubber and Abrasive
WORK TOGETHER
for
FASTER, BETTER

★ **BURRING**
★ **FINISHING**
★ **POLISHING**

Brightboy's combination of rubber and abrasive in exact "balance" produces a unique action that simultaneously burrs, finishes and polishes; eliminates the production steps between the grind and the buff; assures faster, close-tolerance finishing; improves precision control and work quality. A Brightboy finish often constitutes the final polish.

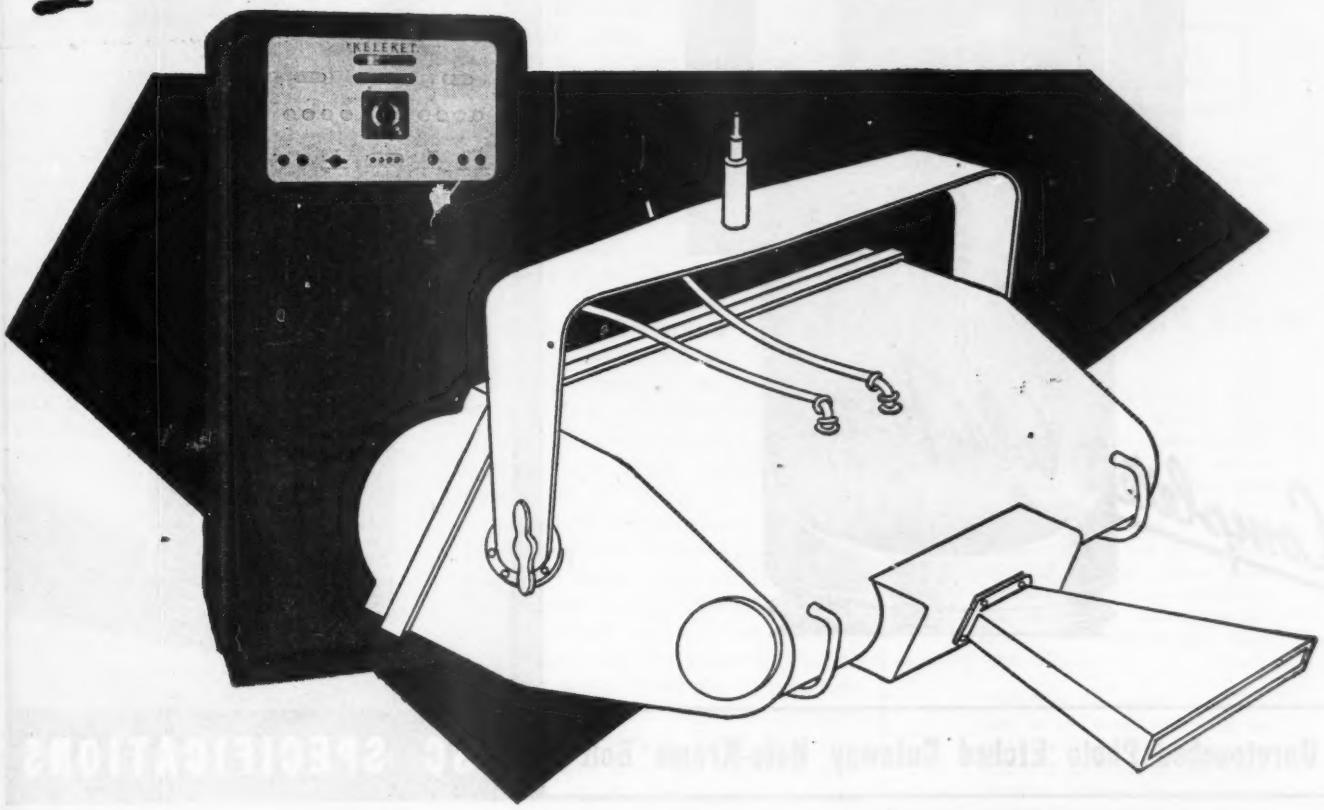
Ask your distributor to tell you, now, how Brightboy can fit into your present and post-war production. Get Brightboy samples, prices, production assistance and working data from Brightboy field men, always at your service.

BRIGHTBOY INDUSTRIAL DIVISION
Weldon Roberts Rubber Co.
Newark 7, N. J.

WELDON ROBERTS
Brightboy

KELEKET *Introduces to Industry*

The 250 KV X-ray Inspection Unit



More Simple * More Dependable * More Efficient

Here's an important new industrial X-ray unit that has plenty of power and penetration to cover the widest range of inspection requirements—yet it is the easiest-to-operate X-ray apparatus produced today. Whatever can be done automatically *is* done automatically—the element of human error has been eliminated to the greatest possible extent. The *machine* does *more*—the *operator* does *less*—and *you* get better results.

A self-contained tubehead, with built-in oil cooler, eliminates separate transformers.

Stepless push-button control provides infinite kilovoltage selection.

Power is instantly and automatically shut off at maximum tube rating.

Pilot lights indicate—not only when there is trouble but shows where the trouble is.

Automatic safeguard permits radiation of X-rays only when cooling water is flowing.

Line compensator is adjustable while unit is in operation.

Constant milliamperage provided by inductive filament regulators and filament compensating transformers.

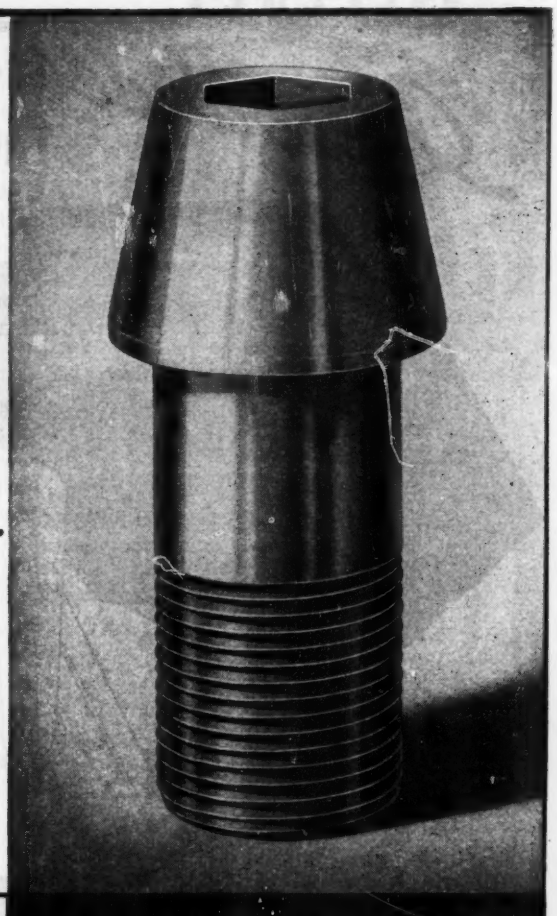
This 250 KV unit can be built into one of KELEKET'S radiographic production cabinets, can be furnished on hand truck, or mounted on either stationary or mobile jib crane.

These and many other individual features make the 250 KV machine the easiest, smoothest-running inspection unit available to Industry today. No other industrial X-ray unit will accomplish as much for you with the simplicity, dependability and efficiency that KELEKET'S 250 offers. Get all details from your KELEKET representative, or write us direct.

KELLEY-KOETT X-RAY MFG. COMPANY
24012 WEST FOURTH ST., COVINGTON, KY.
PIONEER CREATORS OF QUALITY X-RAY EQUIPMENT SINCE 1900

THE STANDARD OF THE AIRCRAFT INDUSTRY

Unretouched Photo Etched Cutaway Holo-Krome Bolt

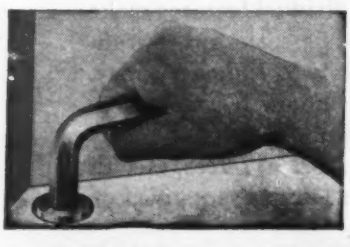


NASC SPECIFICATIONS

HOLO-KROME INTERNAL HEX WRENCHING BOLTS

The BETTER Fastening Method

QUICK & POSITIVE TIGHTENING DUE TO INTERNAL WRENCHING



Solve that seemingly difficult fastening problem by specifying Holo-Krome Internal Hex. Wrenching Bolts. The experience of Design and Production Engineers prove this to be the better fastening method . . . Uniform precision and a finer quality is assured because of the Holo-Krome patented manufacturing process of Completely Cold Forging . . . To be sure—specify "HOLO-KROME" and Save WEIGHT—SPACE—TIME.

AIRCRAFT DIVISION

THE HOLO-KROME SCREW CORPORATION

MAIN OFFICE & PLANT

HARTFORD 10, CONNECTICUT U.S.A.

Compressibility

(*Continued from page 175*)

straight at the wing root. Special emphasis has also been given to the length of the fuselage aft of the trailing edge of the wing to minimize fuselage drag.

Wing

The wing forces and moments also change as a result of compressibility effects. With increase in speed or Mach number the resultant of the lift forces tends to shift toward the trailing edge of the wing. Accordingly, care should be given to the design of the wing trailing edge as a result of this shift in loading. The leading edge of the wing should be very rigid as a result of the increase in pressure. It is extremely important to make the root section as thin as possible, and effort should be made compatible with the installation of machine guns, gas tanks, and landing gear not to exceed a maximum thickness of 12-14 percent.

In this respect, propeller slipstream effects will tend to increase the local speed over the wing immediately behind the propeller.

Wing Dive Flap

In dives at Mach numbers above 0.82, the greatest increase in diving moment, resulting from compressibility, tends to nose the plane down, and control becomes difficult until an altitude of approximately 12,000 ft. is reached. Neither elevator nor full tab motion is very effective, although the full tab deflection will raise the altitude at which pullout is possible, by a few thousand feet. The pullout, when it occurs at approximately 12,000 ft., is relatively sudden and sharp, and excessive load factors may be developed. The solution to this condition was the installation of a dive flap. With this flap a controlled pullout can be achieved at any altitude and Mach number (Figs. 8, 9, 10, 11, and 12).

Propeller

The propeller problem is very important since the propeller's primary purpose is to convert engine horsepower into thrust. A blade section presents the same problem as does an airfoil section, but it involves more difficulties in that we have rotational as well as forward speed. As a result of these two speeds, the problem of compressibility is much more severe.

The general trend of present-day propeller design is toward wider blade chord to alleviate the effects of compressibility on the blade section. Various propellers have been tried on the P-47 to increase the rate of climb performance. The original propeller had a somewhat narrow chord distribution, with result that climb performance was sacrificed. Tests with wider blade chord propellers have increased the rate of climb considerably.

With the introduction of more horsepower and improved turbosuperchargers which increased the critical altitude of the plane at which maximum horsepower can be maintained, six-bladed dual-rotation propellers have been tested to determine their effect on stability, high speed, and rate of climb. The results, to date have been discouraging. More development and research work will have to be devoted to the dual-rotation problem.

Engine Cowl

The engine cowl is very much like an airfoil section in that it has a leading edge radius. The redistribution of forces on the cowl are similar to that of the wing. Care should be taken to avoid sharp curvatures at the leading edge of the cowl, in much the same way as with an airfoil section.

Wind tunnel experiments show that the shock wave is not limited to a particular point on the airfoil but moves within a given neighborhood of points. This phenomenon is called by some the "dancing" shock wave and immediately suggests an uncertainty factor in our theoretical setup. The dancing phenomenon may be quite similar to the Uncertainty Principle in quantum mechanics, where a single wave function of a given type for a free particle corresponds to the physical condition in which the momentum and the energy are exactly known, but the position of the particle is unknown.

The aeronautical engineer should probably content himself with certain "band" values rather than exact values of the aerodynamic forces and moments in the subsonic region of flow. Flight tests have indicated that compressibility effects are not as severe as predicted by theory (Fig. 13). This may be partially explained by the fact that we have not evaluated the influence of viscosity with the attendant boundary layer. The boundary layer probably serves as a cushion and thereby tends to alleviate conditions, since the temperature within the boundary layer is several degrees warmer than the air outside this layer.

In conclusion, these and many other problems challenge our imagination without as yet yielding more than a tantalizing guess as to their real nature. Furthermore, it should not be forgotten that speeds above that of sound are near and cannot be dismissed much longer (Figs. 14 and 15). For the man who wants problems of immediate practical interest to tax his powers to the utmost, compressibility is a happy hunting ground.

MAILING LISTS THAT WORK...

McGraw-Hill Industrial Mailing Lists are a direct route to today's purchase-controlling executives and technicians in practically every major industry.

These names are of particular value now when most manufacturers are experiencing constantly increasing difficulty in maintaining their own lists.

Probably no other organization is as well equipped as McGraw-Hill to solve the complicated problem of list maintenance during this period of unparalleled changes in industrial personnel. These lists are compiled from exclusive sources, based on hundreds of thousands of mail questionnaires and the reports of a nation-wide field staff, and are maintained on a twenty-four hour basis.

Investigate their tremendous possibilities in relation to your own product or service. Your specifications are our guide in recommending the particular McGraw-Hill lists that best cover your market. When planning your industrial advertising and sales promotional activities, ask for more facts or, better still, write today. No obligation, of course.

McGraw-Hill Publishing Co., Inc.
DIRECT MAIL DIVISION
330 WEST 42nd STREET
NEW YORK, 18, N. Y.

. . . . . TO KEEP YOU IN THE CLEAR

You'll be up in the air after the war—flying your own plane when the plans of tens of thousands of sportsmen, business men and aviation enthusiasts for private flying become a reality. Hallicrafters radio telephones for use in your own plane will fit right into those plans. They'll give you greater safety and freedom in the skies. To keep pace with fast breaking developments in aviation, Hallicrafters will be ready with the finest, most dependable two-way radio telephone communications equipment you can get.

hallicrafters RADIO

THE HALLICRAFTERS COMPANY, MANUFACTURERS OF RADIO AND ELECTRONIC EQUIPMENT, CHICAGO 16, U.S.A.